Draft Concept Document

Elliott Bay/Duwamish Restoration Program

Prepared for the
Elliott Bay/Duwamish Restoration Program Panel
by the
Municipality of Metropolitan Seattle
Panel Publication 3

Elliott Bay/Duwamish Restoration Program
NOAA Restoration Center Northwest
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115-0070

(206) 526-4338
(FAX) (206) 526-6665

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To comment on the Elliott Bay/Duwamish Restoration Program's *Draft Concept Document*, contact Robert C. Clark Jr., Administrative Director, at the following address or phone number:

Robert C. Clark Jr., Administrative Director
Elliott Bay/Duwamish Restoration Program
NOAA Restoration Center Northwest
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115-0070
(206) 526-4338 **FAX (206) 526-6665**

Comments on the draft concept document will be accepted through October 15, 1993, including those comments postmarked on that date.

The Panel will hold a public meeting to discuss the draft concept document on September 29, 1993. The meeting will be held from 7 to 9 p.m. at Federal Center South, north auditorium, 4735 E. Marginal Way S., Seattle. A substantial portion of the meeting will be designated for public comment. At 6:30 p.m., the Panel will host an open house to provide opportunities for informal discussion with Panel members. Displays and information will be available. With advance notice, sign-language interpreters can be provided.

Individuals and organizations wishing to receive further information about the Elliott Bay/Duwamish Restoration Program should contact the Administrative Director and ask to be added to the Program mailing list.

This information is available on request in accessible formats for persons with disabilities by calling (206) 684-2046 (voice) or (206) 689-3413 (TDD).

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Executive Summary

This draft concept document describes the process developed for the Elliott Bay/Duwamish Restoration Program (Program) by a Panel (Panel) of participating governments responsible for implementing the requirements of a 1991 consent decree. The consent decree settled a 1990 lawsuit filed by the United States of America on behalf of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) against the City of Seattle and the Municipality of Metropolitan Seattle (Metro). The process described in this document has been used to identify and evaluate potential sites for sediment remediation and habitat development projects. Pollution source control is also discussed. The Panel's process for environmental review and public participation is described as well.

Over the past century and a half, urban development and associated activities have dramatically changed the character of the Elliott Bay and Duwamish River shorelines. The changes have included water and sediment pollution and physical habitat destruction and modification.

Scientific studies have documented the distribution and effects of the pollution. Some pollutants have settled to the bottom and accumulated in sediment, primarily near sewer outfalls, other waste discharge points and areas of heavy industrial activity. Pollutants detected in these areas include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and a variety of other synthetic organic compounds and metals. The concentrations of these substances vary widely from place to place. The extent to which certain marine organisms have been directly affected by pollutants in Elliott Bay is still being studied. However, it is generally understood that the accumulation of pollutants in the sediment in these areas has impaired the habitat value for some life forms. In cases where bottom-feeding fish or shellfish accumulate certain pollutants in their bodies, there may also be some level of risk to people who consume these organisms.

The physical destruction and modification of shoreline habitat has included the straightening of the Duwamish River channel, the building of steep bulkheads and riprap, the filling of marshes and tide flats, and the dredging of adjacent intertidal areas. Combined with water and sediment pollution and the reduction of freshwater flow, these activities have dramatically reduced the quantity and quality of nearshore habitat in the Duwamish River estuary.

The Elliott Bay/Duwamish Restoration Program is a cooperative, intergovernmental program established to help restore and replace natural resources injured by pollution in Elliott Bay and the lower Duwamish River. In the lawsuit against the City of Seattle and Metro, NOAA alleged that the City and Metro had caused some of this injury by releasing hazardous substances from their sewerage systems into the bay and river.

Rather than expend substantial time and resources on legal proceedings, the parties to the lawsuit agreed to cooperate in the formation of the Elliott Bay/Duwamish Restoration Program. This agreement was embodied in a consent decree. An important provision of the consent decree is that this program is not intended to remedy all the injuries to natural resources in Elliott Bay and the lower Duwamish River. Rather, it is intended to maximize benefits to the area's natural resources and residents by coordinating the actions of the consent decree parties and other governments and agencies.

The consent decree parties, which are now jointly conducting the Program as a Panel, are NOAA, the U.S. Department of the Interior's Fish and Wildlife Service (USFWS), the Muckleshoot Indian Tribe, the Suquamish Tribe, the Washington State Department of Ecology (Ecology), the City of Seattle and Metro. Under the consent decree, the City and Metro are providing a combined maximum of $24 million for sediment remediation, habitat development and pollution source-control projects between 1992 and 1997. Of the $24 million allocated, $12 million is set aside for sediment cleanup, $5 million for habitat restoration, up to $5 million in real estate for habitat sites restored by the Program and up to $2 million for helping control the sources of pollution that could recontaminate project sites.

Since the consent decree was signed in 1991, the Panel and two technical working groups — one for sediment remediation and one for habitat development — have been working to identify and prioritize potential sediment cleanup and habitat development projects. With comments from the public, they have established an initial list of possible projects, developed criteria reflecting the requirements of the consent decree and ranked the projects based on these criteria. This concept document presents the criteria, the ranking methods, the results of the ranking calculations and the list and description of projects in the resulting order of priority. The Panel will establish the final order of priority for the projects after it receives public comments on this concept document.

Once the order of priority is established, the Panel will select sites for the few projects that can be implemented with the time and budget available and will begin planning and implementing those projects. Planning and implementation will involve a variety of activities, including additional site characterization, detailed environmental reviews and audits, possible real estate negotiations, project design, permit application and project management. The Panel will oversee project design and implementation and establish followup monitoring programs to assess project success.

To protect natural resources and prevent recontamination of sites selected for sediment remediation and habitat development projects, the Panel will establish source control goals. To achieve these goals, the City of Seattle and Metro will determine what actions or changes, if any, are needed in connection with their ongoing source control programs. If they decide actions or changes are needed and are also achievable, they will propose those actions or changes to the Panel. Upon Panel approval, the actions or changes will be undertaken.

Environmental review of Panel projects will be conducted under the National Environmental Policy Act (NEPA) and State (of Washington) Environmental Policy Act

(SEPA). To maximize efficiency, the two reviews will probably be conducted jointly for each project. Under this approach, a NEPA environmental assessment (EA) will be prepared and then adopted to satisfy SEPA environmental review requirements. The public will have a period of at least 30 days to comment on environmental review documents.

The Panel will continue to work with the public throughout the life of the Program, keeping the public informed of Program activities and soliciting public comments and suggestions to help guide Panel decisions. The Panel will seek public comment on this concept document, environmental reviews and other aspects of specific Program projects. Specific information on commenting on this concept document is provided in the cover letter accompanying this document and at the front of this document behind the title page.

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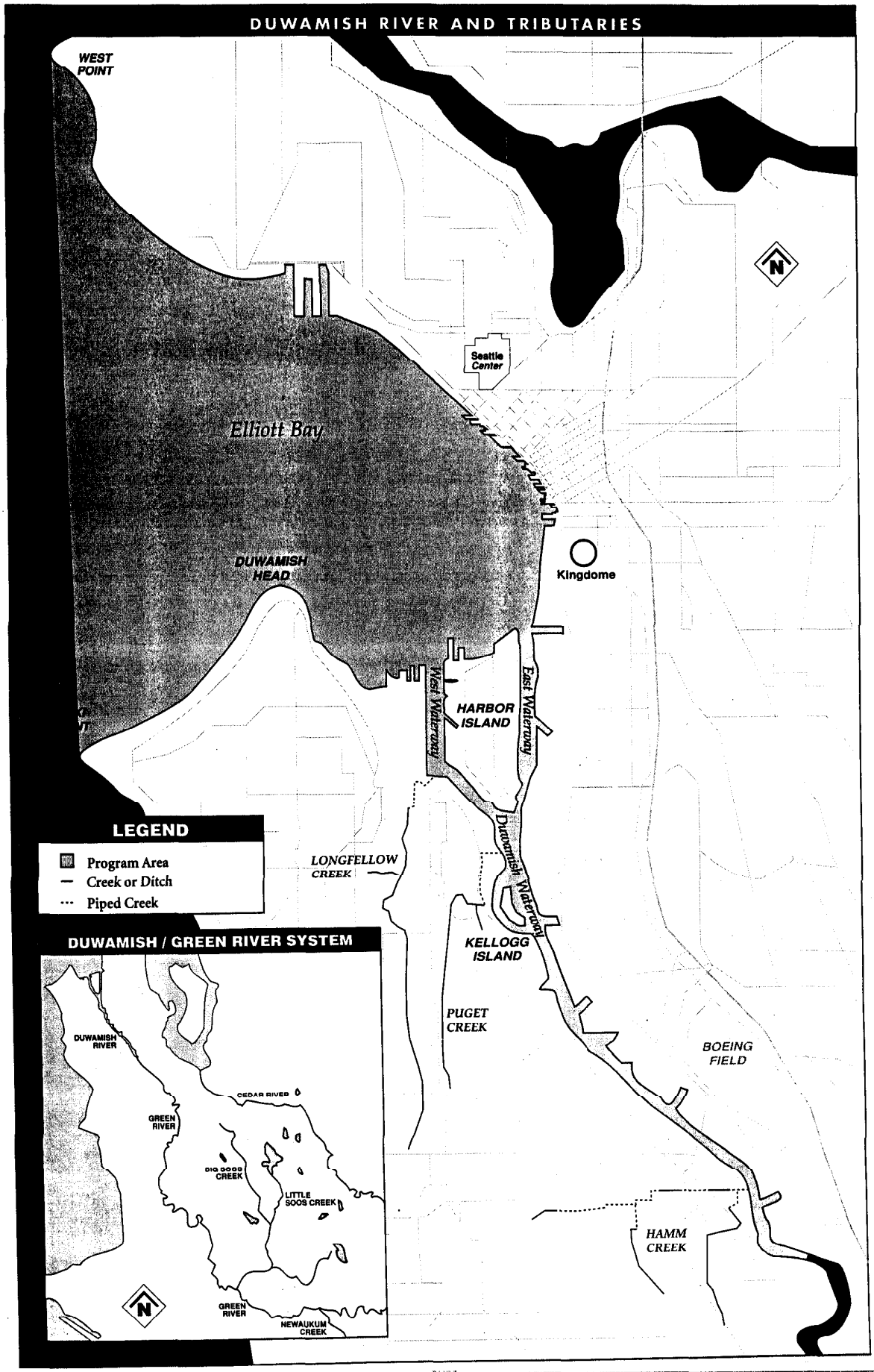
Elliott Bay / Duwamish Restoration Program



1. Introduction and Overview

This draft concept document describes the process developed for the Elliott Bay/Duwamish Restoration Program (Program) by a Panel (Panel) of participating governments responsible for implementing the requirements of a 1991 consent decree. The consent decree settled a 1990 lawsuit filed by the United States of America on behalf of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) against the City of Seattle and the Municipality of Metropolitan Seattle (Metro). The process described in this concept document has been used to identify and evaluate potential sites for sediment remediation and habitat development projects. Pollution source control is also discussed. The Panel's process for environmental review and public participation is described as well. This concept document presents the context within which actions will be taken by the Elliott Bay/Duwamish Restoration Program to improve the natural resources of Elliott Bay and the lower Duwamish River.

What this document covers

- Background information on the Elliott Bay/Duwamish Restoration Program, establishment of the Program through a consent decree, accomplishments of the Program to date, opportunities for public participation in the Program, and the environmental assessment process (Chapter 1).
- The geographic scope of actions to be undertaken by the Program and the general environmental condition of Elliott Bay and the lower Duwamish River (Chapter 2).
- Existing sediment remediation, habitat development and pollution source-control programs that may affect Panel-sponsored projects in Elliott Bay and the lower Duwamish River (Chapters 3-5).
- Evaluation and ranking of potential sites for sediment remediation and habitat development (Chapters 3-4).
- The scope of environmental assessments that will be undertaken on a site-by-site basis to evaluate the environmental impacts of alternative actions at each site selected by the Program for sediment remediation and habitat development (Chapters 3-5).

Program foundation

Factors leading to the consent decree

Under its authority as a natural resource trustee provided by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), NOAA filed a lawsuit against the City of Seattle and Metro on March 19, 1990, to recover damages "for injury to, destruction of, and loss of natural resources resulting from releases of hazardous substances . . . into the environment in and around the Duwamish River and Elliott Bay, for the costs of restoring, replacing or acquiring the equivalent of the affected natural resources, and for the costs of assessing the damage to the affected natural resources" (Consent Decree, 1991). The City and Metro maintained that effluent discharged from their combined sewer overflows (CSOs) and storm drain outfalls had presented little, if any, potential for injury to the natural resources in Elliott Bay and the Duwamish River (Consent Decree, 1991). Rather than go through a costly and time-consuming legal process, the parties to the lawsuit worked out a settlement agreement to carry out a program that would help restore and replace the natural resources of Elliott Bay and the lower Duwamish River. These natural resources include fish and wildlife and the fisheries resources associated with coastal and offshore waters of the United States. The settlement agreement was embodied in a consent decree. (Further details are available in Appendix A.)

Consent decree goals and requirements

The primary goal of the Program established by the consent decree is to remediate contaminated sediment and restore natural habitat associated with combined sewer overflows and storm drains in Elliott Bay and the lower Duwamish River. Combined sewer overflows are sewerage system overflows caused by the introduction of large volumes of stormwater runoff into the system during heavy rain. The consent decree established the Elliott Bay/Duwamish Restoration Program to meet this primary goal of remediation and restoration through sediment cleanup, aquatic and shoreline habitat development, and pollution source-control projects. Figure 1 shows the Program's components and the funding for each.

One of the consent decree's most important provisions is the statement that the Program by itself cannot and is not intended to restore or replace all natural resources injured by pollution in Elliott Bay and the lower Duwamish River. Instead, the Program is intended to coordinate with other federal, tribal, state and local government programs that are working toward the same goal. These programs are listed in Chapters 3-5. The Panel anticipates a combination of projects that will maximize the resources made available by the consent decree and integrate the projects with other existing and planned enhancement projects.

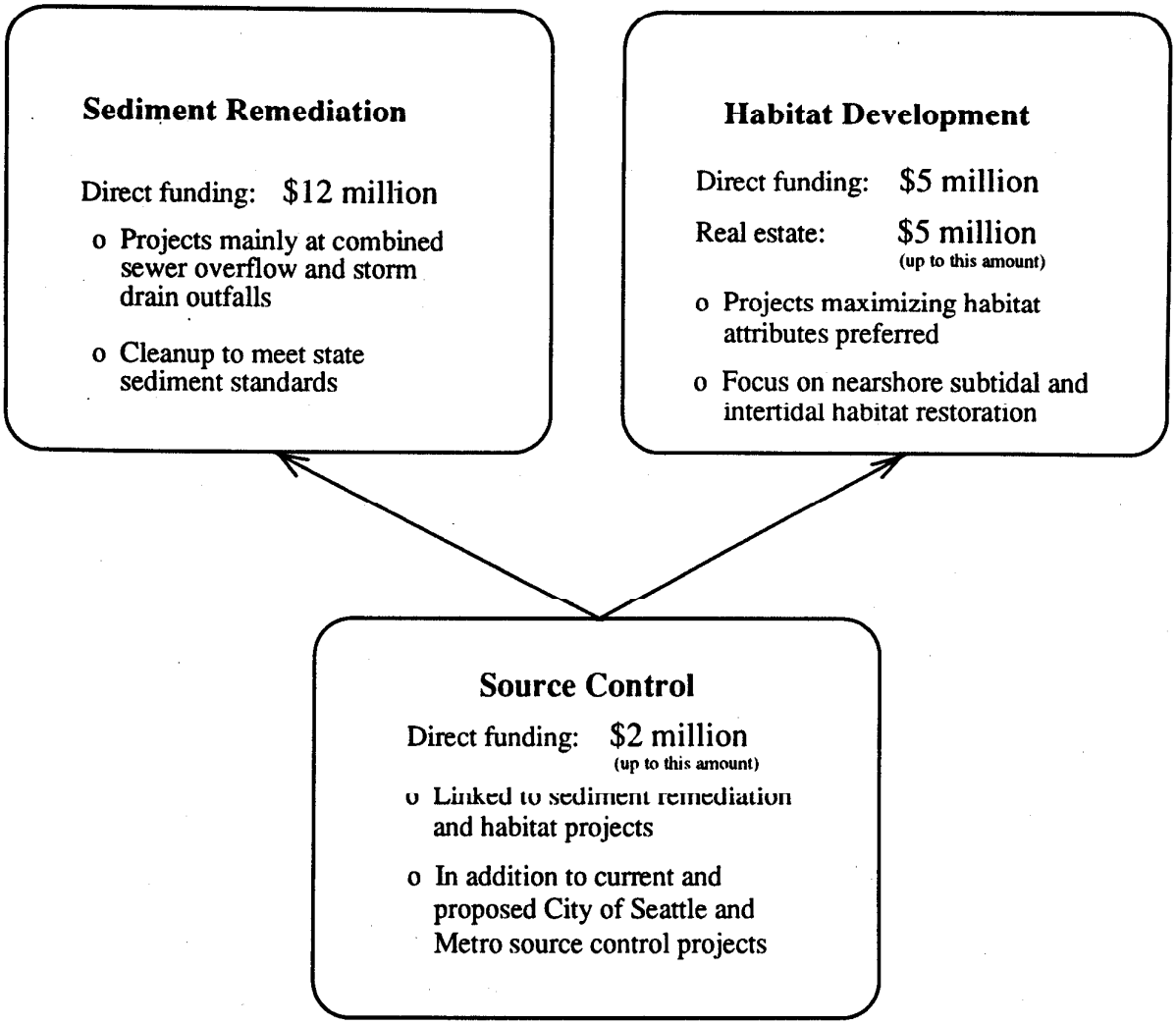


Figure 1

Elliott Bay/Duwamish Restoration Program Components

Participating governments

The governments participating in the Program — the parties to the consent decree — and their roles are listed below. These governments are working closely together and with other concerned governments, agencies and the public to carry out the Program.

United States of America. The federal government is represented by NOAA and the U.S. Department of the Interior's Fish and Wildlife Service (USFWS). These agencies serve as natural resource trustees, protecting national interests of the public in fish, wildlife and other natural resources.

State of Washington. The State of Washington is represented by the Department of Ecology (Ecology), which also coordinates involvement by the state Departments of Fisheries, Wildlife and Natural Resources. Ecology serves as a natural resource trustee for the state's natural resources in Elliott Bay and the lower Duwamish River.

Muckleshoot Indian Tribe and Suquamish Tribe. The Muckleshoot Indian Tribe and Suquamish Tribe are also natural resource trustees. They protect tribal interests in the natural resources of Elliott Bay and the lower Duwamish River in connection with treaty rights delineating usual and accustomed fishing areas.

City of Seattle and the Municipality of Metropolitan Seattle (Metro). The City of Seattle and Metro are responsible for funding the Program and contributing real estate and in-kind services to help carry out the Program.

Overview of Program process

The consent decree provides a structure and process for carrying out the Program. These elements are shown in Figure 2 and described briefly below. A detailed discussion is provided in Appendix A.

The consent decree established an intergovernmental Panel of Managers to direct the Program. Representatives of NOAA, USFWS, Ecology, the Muckleshoot Indian Tribe, the Suquamish Tribe, the City of Seattle and Metro comprise the Panel.

The Panel has set up two technical working groups to identify and implement projects: the Habitat Development Technical Working Group and the Sediment Remediation Technical Working Group. Each working group includes representatives of the governments on the Panel, other governments and agencies, and interested parties. The groups are responsible for identifying potential projects, evaluating them against criteria that meet the goals of the consent decree and determining their feasibility. After the Panel selects projects, the working groups oversee their implementation. The groups are also responsible for advising the Panel on proposed source control projects related to project sites.

The Panel will establish source control goals to protect natural resources and prevent the recontamination of project sites. The City and Metro will determine whether additional source control is needed beyond their ongoing programs to meet the source control goals. If additional source control is needed, the City and Metro will propose actions to the Panel and implement the actions approved by the Panel.

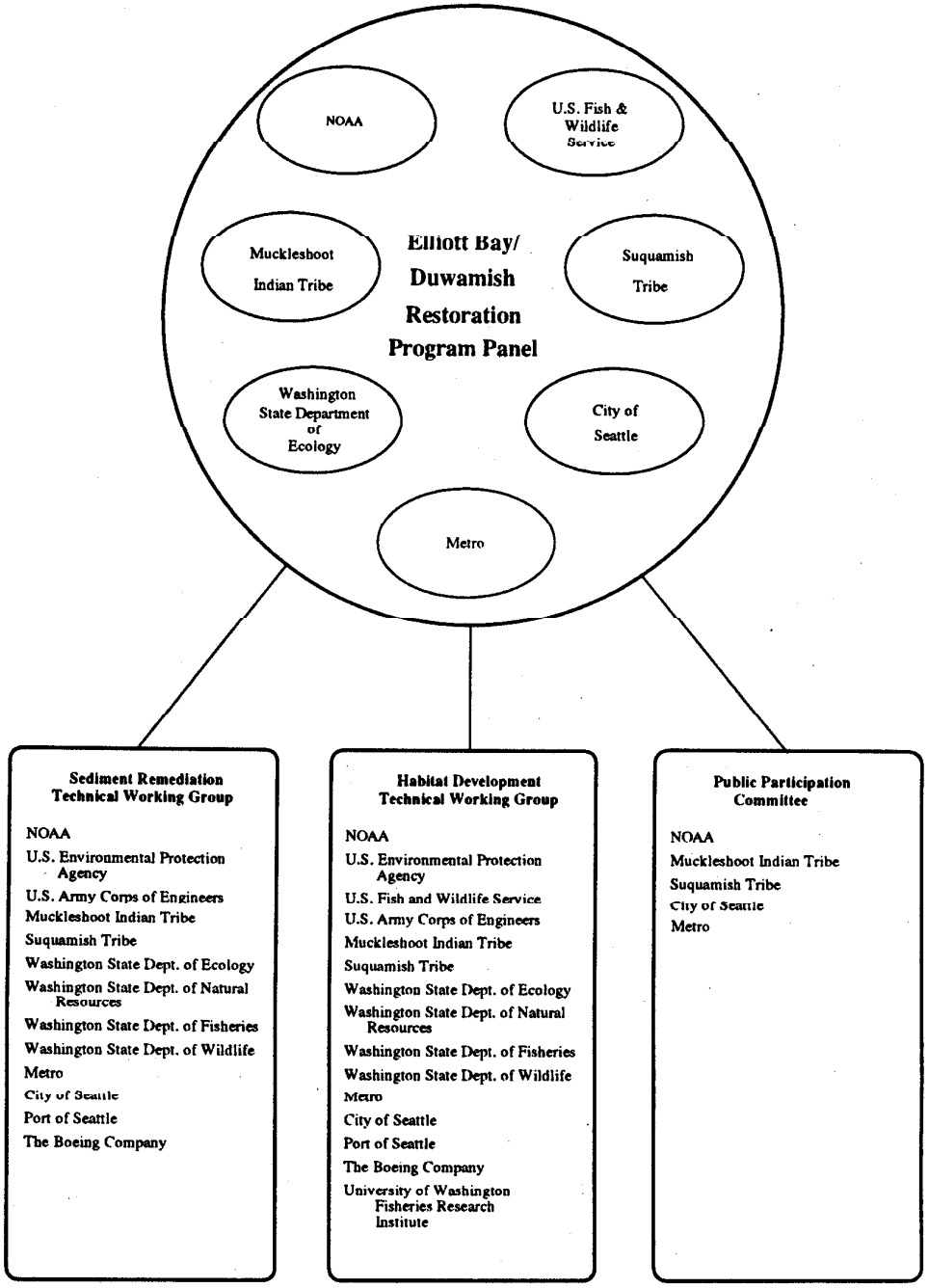


Figure 2

Elliott Bay/Duwamish Restoration Program Structure

The Panel has established a Public Participation Committee to advise the Panel on public participation activities and distribute timely, accurate and complete information about the Program to the public. Representatives of governments on the Panel comprise the committee.

Program description

The geographic area covered by the Program is Elliott Bay (specifically, east of a line between Alki Point and West Point) and the lower Duwamish River from the turning basin at the head of navigation located at about river mile 6, or approximately South 102nd Street. Solely for purposes of habitat development, the Program may also cover tributaries to the Duwamish River. The Program area is shown in Figure 3. The consent decree's complete description of the Program area is provided in the glossary.

Summary of Program alternatives and components

This section gives brief introductory descriptions of the Program's components. Detailed discussions are provided in Chapters 3-5. The consent decree's complete definition of these components is provided in the glossary.

Sediment Remediation. The Panel anticipates undertaking four to five sediment remediation projects. These projects will each use one or more methods to remove or isolate contaminated sediment in the project area. Examples of methods that could be used include dredging and disposal, dredging with sediment treatment and replacement, and capping (covering contaminated sediment with a layer of clean sediment).

Habitat Development. The Program anticipates undertaking three to five habitat development projects. These projects will each use one or more methods to restore and/or replace estuarine habitat. Examples of methods that could be used include fill removal, regrading and excavation; stream daylighting; revegetation; substrate modification; water depth changes; and contaminant removal.

Source Control. The consent decree requires that the Panel approve source control efforts where necessary to protect natural resources and prevent recontamination of project sites. Examples of source control methods include reducing, rescheduling or eliminating combined sewer overflows; investigating and controlling potential point sources of pollution; implementing best management practices; and educating people about nonpoint pollution in the watershed.

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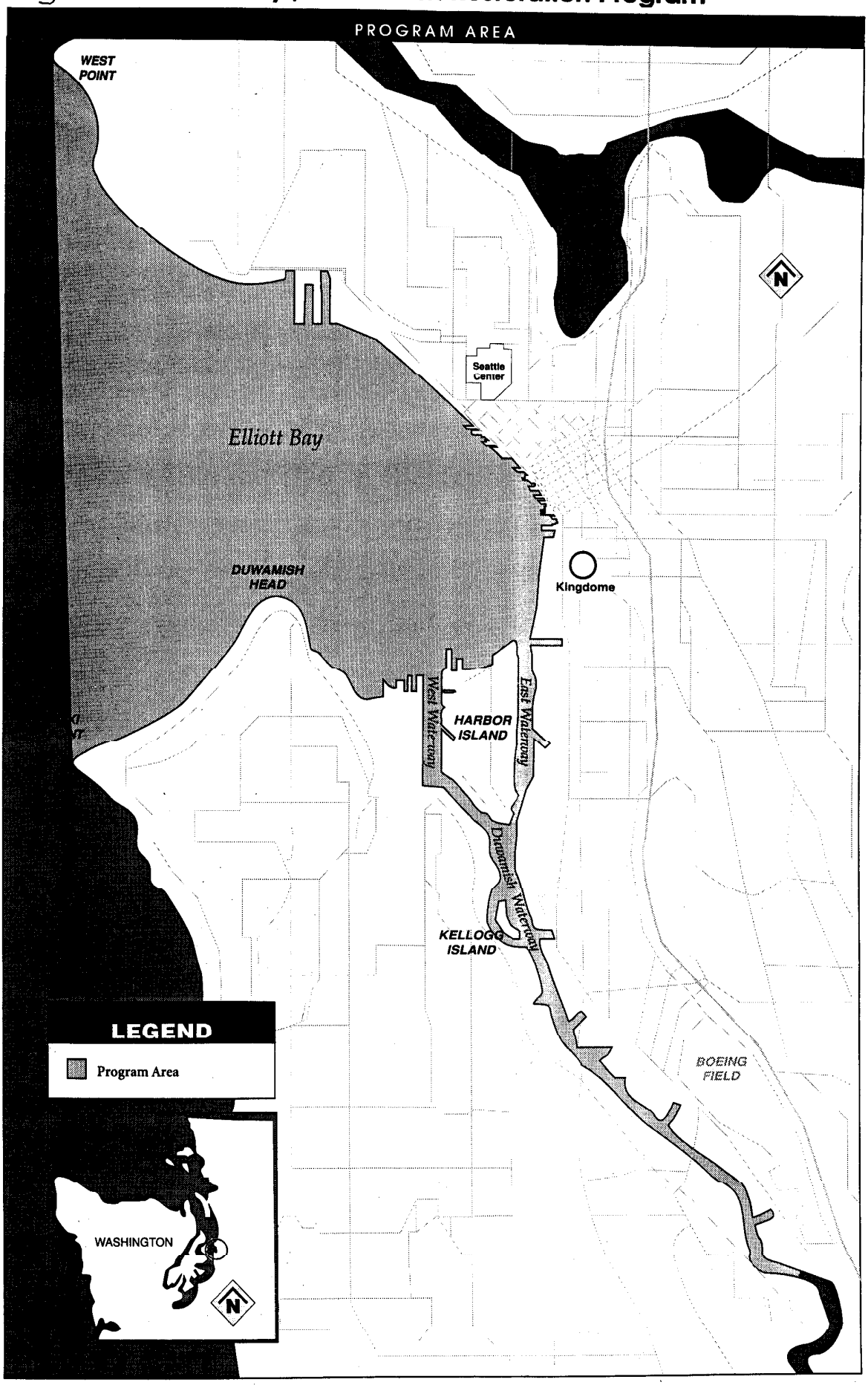

Schedule

Some projects will be designed and completed by the end of the funding period in 1997. Some project completion and monitoring will likely extend beyond that time. One sediment remediation project, called the Pier 53-55 Sediment Remediation Pilot Project, was implemented in 1992.

The public's role

The Panel encourages comments on the environmental issues and other issues that may be associated with the Program. Public participation is an essential part of the environmental review process and the Program's activities — in fact, it is required by the consent decree and federal and state law. The participating governments and agencies are committed to meeting these requirements. The public's comments on the environmental issues associated with the Program have been sought early and will continue to be sought throughout the Program. Comments recorded at public meetings and workshops held so far are included in Appendix B. These comments and future comments will help the environmental review focus on the most important environmental issues. The Panel will consider all comments. Directions for commenting on this concept document are provided in the cover letter accompanying this document and at the front of this document behind the title page.

As the Program moves ahead, there will be other opportunities for public participation. Individuals and organizations on the Panel's mailing list will periodically receive information about the Program's progress. Information will include notices about upcoming meetings, workshops and other opportunities to learn about and comment on the Program. Some of these opportunities will be formal comment periods, meetings or hearings on environmental review documents and permits for individual sediment remediation and habitat development projects. A list of potentially applicable permits is provided in an Ecology publication, "Commonly Required Environmental Permits for Washington State," September 1990.

Environmental review

The National Environmental Policy Act (NEPA) requires federal agencies to evaluate the potential environmental impacts of many projects under their jurisdiction. The State (of Washington) Environmental Policy Act (SEPA) requires state and local agencies to carry out similar evaluations. Because Elliott Bay/Duwamish Restoration Program projects will fall under both federal and state jurisdiction, the environmental evaluation requirements of both NEPA and SEPA will have to be met. To minimize duplication, SEPA allows state and local agencies to adopt the NEPA environmental review of a project as the process for meeting SEPA requirements. The Panel will use this approach for Elliott Bay/Duwamish Restoration Program projects.

A NEPA environmental assessment (EA) will be prepared for each selected project to evaluate its potential environmental impacts. When each EA is completed, it will be made available for public comment for at least 30 days. Because an EA may be adopted to meet SEPA requirements at the same time, this one comment period may be used to meet the requirements of both laws. If an EA is adopted for SEPA at a later time, an additional comment period might be provided.

To minimize redundancy, the Panel will use a tiering approach to prepare the EAs. Under a tiering approach, the first EA prepared for a class of projects will include a full discussion of potential impacts, including issues raised in this concept document. EAs for subsequent projects in that class will not repeat the full discussion. Instead, they will summarize and refer to the first EA; focusing on additional issues or different impacts associated with the new projects. The EA for an individual project may indicate that a full environmental impact statement (EIS) should be prepared for that project. In that case, if the Panel decides to proceed with the project, an EIS will be developed in a manner that satisfies both NEPA and SEPA.

2. Current State of the Environment

Pollution sources and processes

Elliott Bay and the lower Duwamish River are urban waters largely within the City of Seattle, with some sections of the river in the Program area also flowing through the City of Tukwila and unincorporated King County. Over the years, there has been a wide variety of harmful waste discharges into Elliott Bay and the lower Duwamish River. These discharges have come from urban and industrial activities as well as from accidental and intentional disposal of contaminants. Some of these contaminants have settled to the bottom and accumulated in sediment near the shore, causing pollution and degradation or loss of habitat for fish, other aquatic life, birds and mammals.

Areas of contaminated sediment tend to be located at or near areas of existing or historic industrial activity or at existing and historic areas of untreated sewage discharges. The types and amounts of contaminants at each of these locations depend on the source of the contaminants. Contaminant concentrations in sediment receiving discharges from industrial activities typically tend to be higher than those in sediment receiving discharges from sewer outfalls. The waters and sediment in the deeper, offshore areas of Elliott Bay and the navigation channel of the Duwamish River are generally less contaminated than nearshore areas and so are of less concern to the Program.

Pollution at sewer outfalls usually consists of a wider variety of substances than pollution at locations associated with specific industrial sources. This difference results from the fact that each sewer outfall discharges wastewater collected from a large drainage basin of up to a few square miles, containing contaminants from a potentially wide variety of industrial, commercial and/or residential activities. Pollution at discontinued outfalls follows the same pattern. Figure 4 shows the locations of current outfalls in the Program area.

From the late 1800s when Seattle's sewerage system first came into use until the mid-1960s, wastewater discharged to Elliott Bay and the Duwamish River was not treated. After Metro completed the West Point Treatment Plant in 1966 and subsequently installed an interceptor pipeline along the Duwamish River and Seattle waterfront to carry wastewater to the plant, the discharge of untreated sewage from many outfalls was eliminated.

To prevent potential sewer backups and flooding during heavy rains, these outfalls were converted for use as a combined sewer overflow to allow the overflow of sewage and stormwater during these rains. These improvements substantially reduced the amount of pollution being discharged from the sewerage system to the bay and river. Industrial pretreatment and waste reduction programs implemented by Ecology, the City of

Seattle and Metro have further reduced the amount of pollution being discharged to the sewerage system.

In addition, the diversion of the East Division Reclamation Plant (formerly named the Renton Treatment Plant) outfall from the Duwamish River to a deep-water discharge in outer Elliott Bay has substantially lowered the contaminant loading of the river. Nonetheless, contaminants remain in sediment at old outfall locations and continue to accumulate, though at lower rates, at some active combined sewer overflow and storm drain outfalls.

Over the years, many industries moved into areas along the lower Duwamish River and parts of Elliott Bay. In areas with numerous industries, as in areas with combined sewer overflow and storm drain outfalls, chemical pollution can be extensive because of past uncontrolled or illegal discharge practices. As with the sewer outfalls, historic rates of industrial pollution have usually been higher than current rates. In recent years, numerous programs have helped reduce the amount of chemical pollution discharged by these industries. In fact, very few industries currently discharge permitted wastewater to the Duwamish River or Elliott Bay — they are instead tied to sewerage systems or provide their own on-site treatment.

Existing sediment and water quality

Much of the concern about and study of pollution in Elliott Bay and the Duwamish River has focused on sediment, which is where pollutants tend to accumulate. However, water pollution is also a concern. Both types of pollution are discussed below.

Sediment

Over the years, discharges from the sources described above have resulted in extensive contamination of bottom sediment in the nearshore areas of the bay and river. Some of the most highly polluted sediment in Puget Sound is found around Harbor Island, along the downtown Seattle waterfront and next to the Denny Way combined sewer overflow outfall in Myrtle Edwards Park.

A variety of chemicals makes up the pollution in this sediment. These chemicals include potential carcinogens, such as PAHs (polycyclic aromatic hydrocarbons, which are fossil fuels, products of petroleum combustion and one of the primary components of creosote), phthalates (plasticizers), PCBs (polychlorinated biphenyls) and many more synthetic organic compounds. They also include toxic metals, such as mercury, copper, cadmium, silver, arsenic, zinc and tin. The concentration and extent of these chemicals vary widely from place to place, depending on the volume, duration and chemical composition of discharges as well as on other factors. At many locations, chemicals are at concentrations that exceed state sediment quality standards.

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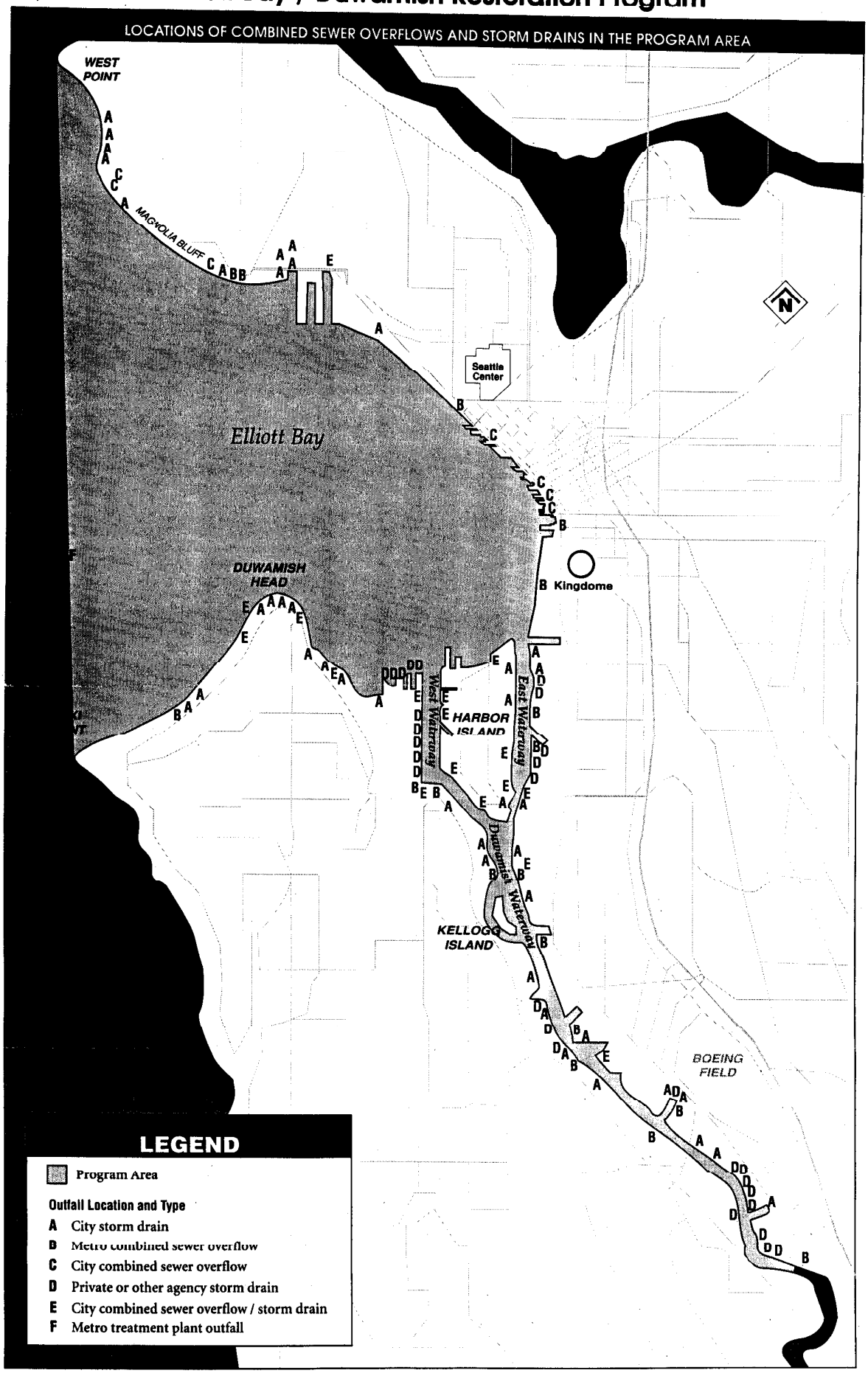


Water column

All the contaminants that end up in sediment pass through the water before being deposited. Many contaminants in the water attach to sediment particles that settle to the bottom. When attached to these particles, the contaminants have little direct effect on water quality. Dissolved contaminants have the greatest effect on water quality.

As with sediment pollution, the degree and extent of water-column pollution vary widely from place to place. Water pollution varies much more rapidly because the water is constantly moving. Water movement combines with many other factors — the speed and direction of movement, the chemical and physical properties of the pollutants, and the times and volumes of contaminant discharges, for example — to determine the nature, extent and concentration of water pollution at specific locations and times. Eventually most dissolved contaminants pass out of the Program area's waters through a variety of mechanisms, including settling to the bottom, breaking down, evaporating or being flushed to Puget Sound.

Although urban activities continue to discharge many polluting substances, the overall chemical water quality of Elliott Bay and the lower Duwamish River is good and continues to improve. Localized water quality degradation can occur near pollution sources.

Impacts of development and pollution on the environment

Habitat loss and degradation

Both Elliott Bay and the lower Duwamish River supported a range of estuarine habitat types before development occurred. Nearly all this habitat — about 90 percent — has been eliminated, with the most rapid losses occurring since the turn of the century. This section describes both the original and current estuarine habitats in the river and bay.

Before the lower Duwamish River shoreline began undergoing development early in this century, it supported nearly 4,000 acres of wetland habitat. This habitat consisted of two basic types: lower intertidal and upper intertidal. The lower intertidal habitat, making up about two-thirds of the wetlands by area, was covered by tidal marshes or mudflats at or near the river's mouth. This habitat was regularly flooded at high tide. The upper intertidal habitat, which made up the remaining third of the lower river's wetlands, was covered by forested wetlands and swamps located upstream from the mouth. Although upper intertidal habitat was only inundated during river flood events or the highest tides, the soils were still saturated sufficiently to support wetland vegetation. Both types of habitat supported a wide variety and large numbers of plants and animals (Tanner, 1991).

Several types of development began to affect the lower Duwamish River in the early 1900s. Diversion of tributaries reduced the river's drainage basin by 71 percent and its average flow by more than 70 percent. At about the same time, the river was dredged to create the Duwamish Waterway, replacing nine meandering miles of river with a straight, deep, four-mile-long channel. The effects of eliminating natural shoreline habitat were compounded by the filling of marshes and mudflats, the creation of steep bulkhead and riprap banks, the removal of vegetation and the construction of buildings and pavement. Altogether, these actions eliminated about 98 percent of the lower Duwamish River's wetlands (Blomberg et. al, 1988).

Before development occurred, Elliott Bay supported several types of estuarine habitat. These habitat types included tidal marsh, shallows and flats, sandspits, and gravel-cobble, for a total of nearly 600 acres. Much of the area covered by tidal marsh and sandspits was located in Smith Cove and a small lagoon near the current Pier 46. Both habitat types were almost completely eliminated by development, largely through filling. Shallow sand flats were located mainly between Duwamish Head and the Duwamish River mudflats and in Smith Cove. Again, nearly all this habitat type was eliminated by development, primarily through filling. Gravel-cobble extended north along the shoreline from Pier 46 to an area beyond Four Mile Rock. Today, the estimated 70 acres of this habitat type remaining are in isolated pockets scattered between Duwamish Head and Piers 90-91 and in the band that extends north from these piers to an area beyond Four Mile Rock (Simenstad, 1987).

It is presumed that the loss of intertidal habitat along Elliott Bay and the lower Duwamish River has had an adverse impact on fish and wildlife resources. Juvenile chum and chinook salmon are known to be especially dependent on salt marsh and mudflat areas because they use these areas for foraging during their period of transition to the marine environment. Studies have shown food organisms consumed by these species to be most abundant in areas of mud and sand flats — habitats historically abundant in the Duwamish River and now relatively scarce — especially when located adjacent to tidal marsh vegetation (Leon, 1980; Meyer et. al, 1981). Developed shoreline areas had much lower food organism abundance. Loss of natural intertidal habitat is, therefore, likely to lead to juvenile salmon having a reduced ability to feed and, consequently, a reduced ability to survive.

Other biological impacts

Pollution of sediment and the water column may have affected some fish and other aquatic life in the Program area. A number of studies have attempted to assess pollution effects on English sole in Elliott Bay and the Duwamish River (Malins et. al., 1980; Malins et. al., 1982; Landolt et. al., 1987; Myers et. al., 1988). The studies focused on English sole because, as a bottom-dweller, its exposure to contaminated sediment could be relatively high and because higher prevalences of liver lesions had been detected in this species compared with other Puget Sound species. Several of the studies measured the levels of PCBs, pesticides and mercury in English sole because these pollutants tend to accumulate in animal tissue. High levels of PCBs were found in many of the studied

specimens but, with a few exceptions, the levels of pesticides or mercury were not found to be high. The highest concentrations of PCBs were found in specimens in the East and West waterways of the Duwamish River. PCB concentrations tended to decrease with increased distance from this area.

To assess the potential effects of pollutants on English sole, the collected specimens were examined for external deformities, liver lesions and cellular abnormalities. By statistically significant margins, the studies found abnormalities at levels greater than those in less polluted portions of Puget Sound. The highest percentage of fish with abnormalities tended to be in the upper part of the Duwamish Waterway or around Harbor Island. Fewer of the fish collected along the shores of Elliott Bay exhibited these abnormalities.

At least two studies (McCain et. al., 1988; Varanasi et. al., 1993) found that juvenile chinook salmon tested in the Duwamish Waterway were exposed to higher levels of PCBs, PAHs and other synthetic organic chemicals than were their counterparts in the Nisqually River estuary, a system less impacted by industrial pollutants. The Duwamish Waterway salmon were exposed to these pollutants by feeding on contaminated bottom-dwelling organisms. The Varanasi study also found that the immune system response in chinook salmon smolts from the Duwamish Waterway was lower than the immune system response in smolts from the Nisqually River. Further investigation is needed to determine what the long-term impacts of these immune system effects may be and whether exposure to these chemicals will lead to other adverse effects on these fish.

Benthic (sediment-dwelling) organisms, such as worms, mollusks and crustaceans, may also be affected by pollution. A 1988 study of the Program area (U.S. Environmental Protection Agency, July 1988) found there were substantially fewer species and individuals per species in some parts of the Program area than there were in less polluted areas of Puget Sound. Furthermore, pollution-tolerant species tended to dominate the species mix in the more highly polluted areas. The areas showing these effects to the greatest degree were along the north shore of Harbor Island, in the West Waterway and near Kellogg Island. These areas also tended to have the highest levels of sediment pollution.

Impacts on people

Health effects

It is not clear whether or not the pollutants in Elliott Bay and the lower Duwamish River have affected human health. Health effects could occur through bodily contact, ingestion of water or sediment, or the eating of contaminated seafoods taken from these waters. The studies that have been done on this subject have focused on the degree of risk posed by eating seafood, such as bottom fish, shellfish and kelp. One of the more recent studies (EPA. September 1988a) found that eating seafood taken from Elliott Bay posed a cancer risk high enough to be of concern, largely because of the relatively high levels of PCBs in bottom fish. This study also evaluated the health risk posed by seven other chemicals

of concern: cadmium, lead, mercury, arsenic, carcinogenic PAHs and the pesticides, HCH and DDT. The study concluded that the risk associated with any one chemical was not high enough to be of concern. EPA did, however, advise fishermen of the elevated risk.

Loss of use

Both pollution and development have affected human use of the Program area's aquatic resources. Because of potential health risk, the Seattle-King County Department of Public Health advises people not to dig or eat shellfish in Elliott Bay nor to take or eat resident fish from the Duwamish Waterway. Traditional tribal fishing areas have been lost because of many shoreline development projects in Elliott Bay and the lower Duwamish Waterway. Recreational uses, such as swimming, may have declined because of the public perception of industrialization, pollution and probably aesthetics. While scuba diving is extensive on the west side of Elliott Bay, divers face little health risk because they ingest only small amounts of water and wear wetsuits that provide protection against skin contact with contaminated sediment.

3. Sediment Remediation

To maximize the Program's effectiveness, the Sediment Remediation Technical Working Group has been systematically evaluating the Program area to identify sediment remediation project opportunities that would best achieve the Program's goals. The evaluations have been carried out through a structured project identification and screening process. This process has involved developing criteria that reflect Program goals, prioritizing the criteria, identifying potential projects and evaluating these projects against the criteria. This process is described in detail below. A list of the identified projects follows the detailed description.

The Panel has also identified steps for completing project selection, implementing projects and assessing project success. These steps include selecting specific sites, selecting approaches to projects from applicable alternatives, estimating project schedules, identifying project success criteria, conducting post-implementation monitoring and determining the relationship of each project to other Program elements. These steps are discussed below.

To provide background and context, this chapter begins with a description of other government programs.

Other government programs

In the 1980s, federal, state and local governments and agencies began conducting programs involving a variety of sediment remediation activities in Elliott Bay and the lower Duwamish River. Many of these programs are ongoing. This section gives a brief overview of these programs. The Elliott Bay/Duwamish Restoration Program has been coordinating its efforts with these activities.

U.S. Army Corps of Engineers. The Corps regulates the discharge of dredged or fill material in Puget Sound under Section 404 of the federal Clean Water Act of 1972. The agency also regulates in-water dredging, filling and construction under Section 10 of the Rivers and Harbors Act of 1899. The Corps participated in the Puget Sound Dredged Disposal Analysis (PSDDA) program with EPA and the state departments of Ecology and Natural Resources. These agencies established open-water dredge disposal sites for clean dredged material. The Corps now manages the sediment evaluation and approval process for dredgers wishing to use the sites.

Environmental Protection Agency — National Estuary Program. EPA has designated Puget Sound as an estuary of national significance under the National Estuary Program. There were several local programs that helped respond to this designation,

including the Puget Sound Water Quality Authority's management plan and Ecology's urban bay action plans. The National Estuary Program promotes the development and implementation of management directives for pollution control in the estuary.

Environmental Protection Agency/Ecology — Superfund/Model Toxics Control Act (MTCA). Under federal Superfund legislation, EPA may designate highly contaminated areas for investigation and cleanup. Harbor Island, at the mouth of the Duwamish Waterway, has been so designated. The site investigation has been completed and final reports have been issued. Because Superfund does not address petroleum pollution, Ecology is overseeing the cleanup of petroleum-contaminated sites on Harbor Island under the jurisdiction of MTCA, the state cleanup law. Several other Elliott Bay and Duwamish River sites are undergoing sediment cleanup evaluations under MTCA.

Elliott Bay Action Program. The Elliott Bay Action Program is a cooperative program involving EPA, Ecology, the City of Seattle, Metro, the Port of Seattle, King County and other governments and agencies. The program identifies toxic contamination problem areas, identifies sources of pollutants, documents schedules for correcting toxicant problems and identifies agencies for taking corrective actions. In 1988, the program completed an action plan that listed pending or proposed actions. For several years, participating agencies have focused the program's efforts on identifying and reducing pollution from industrial sources in the lower Duwamish River.

Ecology — Sediment standards development. Ecology has developed sediment management standards for Puget Sound marine sediment. These standards, which were adopted in March 1991, have three parts: (1) Sediment Quality Standards that define concentration levels acceptable anywhere in Puget Sound; (2) Sediment Source Control Standards that regulate impacts to sediment from wastewater and stormwater discharges; and (3) Sediment Cleanup Standards that establish the sediment cleanup process and cleanup standards for contaminated sites. Ecology has established a sediment management group to help implement the standards. Several sites in Elliott Bay, including Terminal 3, ARCO Harbor Island and Unocal Pier 71, are now or are expected to be undergoing cleanup studies.

Puget Sound Water Quality Authority. The Puget Sound Water Quality Authority has developed a comprehensive plan for Puget Sound water quality protection that state and local governments are responsible for implementing. The plan has led to programs intended to help improve water and sediment quality in Elliott Bay. These programs include watershed planning, development of sediment quality standards, development of stormwater regulations and improvement in the control of pollutant discharges from permitted facilities.

Washington State Department of Natural Resources (DNR) — Elliott Bay Cooperative Management Plan. This DNR-directed program is intended to identify issues and potential conflicts in managing the natural resources of Elliott Bay and the Duwamish River. Numerous other governments and agencies and a private entity are participating. Participants include NOAA, EPA, USFWS, the U.S. Army Corps of

Engineers, the U.S. Coast Guard, the Muckleshoot Indian Tribe, the Suquamish Tribe, Ecology, the Washington State Department of Fisheries, the Washington State Department of Wildlife, the Puget Sound Water Quality Authority, the City of Seattle, the Port of Seattle, the City of Tukwila, King County, the Boeing Company and Metro. The program's goal is to "reduce to an acceptable level any conflicts concerning issues such as contaminated sediment cleanup, habitat restoration, recreation, fishing, navigation, commerce and other shoreline uses of Elliott Bay and the Duwamish River." The program, which began in July 1992, produced its final report in June 1993 (Washington State Department of Natural Resources, 1993).

Metro. Metro is responsible for the collection, treatment and disposal of wastewater from local municipalities in the Program area. Metro has one treatment plant outfall in outer Elliott Bay, which is the discharge point for the East Division Reclamation Plant in Renton. The completion of Metro's West Point Treatment Plant in 1966 substantially reduced the amount of untreated sewage entering the Program area. Beginning in 1995, the upgrade of this plant to secondary treatment will further improve the quality of the plant's effluent. In addition, the agency operates a combined sewer overflow control program to reduce its discharges to the bay and river. Metro conducts sediment sampling under its NPDES permit for these discharges. Beyond the requirements of this permit, Metro has conducted sediment and water quality investigations in Elliott Bay, the Duwamish River and Puget Sound's central basin. Metro has also helped implement sediment remediation projects, such as the Denny Way Restoration Project, and has supported the development of a sediment cleanup plan for Elliott Bay.

City of Seattle. The City is responsible for the collection and conveyance of municipal wastewater (a responsibility shared with Metro) and stormwater in most of the Program area. The City is conducting a long-term capital improvement program to reduce combined sewer overflows from City sewer lines through the construction of storm drains and combined sewer detention facilities. The City conducts a water quality program that includes water quality sampling and monitoring, best management practices, site inspections and public education. The City recently sponsored a sediment remediation pilot project at Piers 53-55 on the Seattle waterfront in cooperation with the U.S. Army Corps of Engineers and Metro. This pilot project was funded by the Elliott Bay/Duwamish Restoration Program.

Port of Seattle. The Port owns and manages extensive shoreline and submerged property in the Program area. The Port carries out sediment cleanup in association with its dredging projects by removing contaminated sediment from the water. The Port also undertakes site and sediment cleanups in conjunction with its development projects. An example is the confined aquatic disposal of contaminated sediment in conjunction with the Port's development activities at Piers 90-91. The Port monitors sediment associated with its property, thereby enhancing overall knowledge of Program area sediment.

Preliminary project identification

Over the past year, the Panel's Sediment Remediation Technical Working Group has been developing an approach to identify, evaluate and prioritize potential sediment remediation sites in Elliott Bay and the lower Duwamish River. The working group has identified a list of 24 potential sites, which include all combined sewer overflow sites in Elliott Bay and the Duwamish River, plus some large City storm drains. The group is evaluating these sites based on criteria it has developed.

As much as practicable, the working group has focused its sediment remediation activities on City and Metro combined sewer overflows and storm drains. The group, however, has primarily focused on combined sewer overflows because they discharge a mixture of untreated sewage and stormwater during heavy storms and are alleged to be the source of adverse biological effects under the consent decree.

This section describes the process being used to prioritize potential sediment remediation projects. The process consists of establishing and weighting criteria and using the criteria to score potential sediment remediation projects. The projects are listed near the end of this chapter in the priority order that resulted from this process. Following the list is a description of the steps proposed to select and implement projects and measure their success.

Criteria

The criteria selected by the Panel for prioritizing projects according to Program goals are listed below and in Table 1.

Contaminated sediment present (high toxicity).

Guideline: Sites with levels of sediment-associated contaminants that are causally related to resource injury and exceed state Cleanup Screening Levels should be of highest priority.

Rationale: This element addresses Paragraph 25 of the Program consent decree. Sites with high levels of toxic contaminants in sediment serve as sources of these contaminants to biota through food-chain transport, release into the water column or sediment redistribution. Highest priority is given to contamination levels equal to or exceeding state Cleanup Screening Levels.

Control of combined sewer overflows, storm drains, industrial input and recontamination from adjacent sediment is adequate.

Guideline: Sites adjacent to sources for which significant source control actions have been implemented or will be implemented by the time the

Table 1: Sediment Remediation

Potential Site Ranking
(By Category)

DRAFT	SEDIMENT	DEGREE OF	ADDRESSES	ADJACENT	HUMAN	PUBLIC	COORDINATE	TOTAL
	TOXICITY INDEX	SOURCE CON.	INJURY	OTHER SITE	CONTACT	EDUC.	OTHER PROJ.	RANK
WEIGHTING(5 TO 3,HIGH TO LOW)	5	5	3	3	3	3	3	
RATINGS	HIGH	HIGH	INTERTIDAL(H)	YES	HIGH	HIGH	YES	HIGH
	MEDIUM	MEDIUM	SHALLOW(M)	NO	MEDIUM	MEDIUM	NO	MEDIUM
	LOW	LOW	DEEP(L)		LOW	LOW		LOW
MADISON STREET	HIGH	HIGH	INTERTIDAL(H)	YES	MED	HIGH	YES	HIGH
WASHINGTON STREET	HIGH	HIGH	INTERTIDAL(H)	YES	HIGH	HIGH	NO	HIGH
WEST MICHIGAN	MED	HIGH	INTERTIDAL(H)	YES	MED	MED	YES	HIGH
DIAGONAL WAY	HIGH	HIGH	INTERTIDAL(H)	YES	HIGH	MED	NO	HIGH
FLORIDA STREET	MED	HIGH	INTERTIDAL(H)	YES	MED	LOW	YES	HIGH
DUWAMISH PUMP STN	HIGH	HIGH	SHALLOW(M)	YES	MED	MED	NO	HIGH
DENNY WAY	HIGH	LOW	INTERTIDAL(H)	YES	HIGH	HIGH	NO	HIGH
UNIVERSITY STREET	MED	HIGH	SHALLOW(M)	YES	MED	HIGH	NO	HIGH
SLIP 4	LOW	MED	INTERTIDAL(H)	YES	LOW	MED	YES	MED
VINE STREET	LOW	MED	INTERTIDAL(H)	YES	MED	HIGH	NO	MED
INTEREAY	LOW	LOW	INTERTIDAL(H)	YES	HIGH	HIGH	NO	MED
MAGNOLIA	LOW	HIGH	INTERTIDAL(H)	NO	HIGH	MED	NO	MED
S.W. FAIRMOUNT	LOW	HIGH	SHALLOW(M)	NO	HIGH	HIGH	NO	MED
HARBOR/HINDS	MED	MED	INTERTIDAL(H)	YES	LOW	LOW	NO	MED
HANFORD AVE	HIGH	MED	DEEP(L)	YES	LOW	LOW	NO	MED
NORFOLK	HIGH	MED	INTERTIDAL(H)	NO	LOW	LOW	NO	MED
S.MICHIGAN STREET	MED	LOW	INTERTIDAL(H)	NO	HIGH	MED	NO	LOW
LANDER STREET	MED	MED	DEEP(L)	NO	LOW	LOW	YES	LOW
BRANDON STREET	HIGH	LOW	INTERTIDAL(H)	NO	MED	LOW	NO	LOW
KING STREET	HIGH	LOW	SHALLOW(M)	NO	LOW	MED	NO	LOW
FOX AVENUE	LOW	HIGH	INTERTIDAL(H)	NO	LOW	LOW	NO	LOW
EIGHTH AVE	LOW	MED	INTERTIDAL(H)	NO	LOW	LOW	NO	LOW
CHELAN STREET	LOW	MED	DEEP(L)	NO	LOW	LOW	NO	LOW
CONNECTICUT STREET	LOW	LOW	DEEP(L)	NO	LOW	LOW	NO	LOW

remediation project is initiated and for which minimal input of toxic contaminants is expected will be preferred.

Rationale: Input of toxic contaminants from improperly controlled sources adjacent to sites receiving sediment remediation could cause recontamination of sediment and interfere with the beneficial effects of the remediation method. The varying degrees of source control implementation need to be weighted differentially.

Potential for addressing injury to target species/fish.

Guideline: Sites with living estuarine resources having measurable injuries will be preferred.

Rationale: This criterion addresses Item D of the Program consent decree and provides a mechanism for assessing the efficacy of remediation actions. Item D delineates federal interests in seeking recovery of damages for injury to, destruction of and loss of natural resources resulting from the release of hazardous substances; recovery of the costs of restoring, replacing or acquiring the equivalent in natural resources; and recovery of the costs of assessing damage to these resources.

Potential to incorporate extra habitat improvement, or proximity to other habitat projects or sediment remediation sites.

Guideline: Sites adjacent to other areas that have received or have the potential of receiving sediment remediation or habitat restoration are preferred.

Rationale: By combining potential remediation sites with other remediation or restoration sites, the area of improvement can be expanded and cost savings may be possible.

Potential for human health risk.

Guideline: Sites that have higher potential risks to public health will be preferred.

Rationale: Sites near areas with public access that have high levels of certain toxic contaminants and/or infectious agents could adversely affect human health as a result of direct contact or through consumption of contaminated species.

Potential for public education.

Guideline: Sites in areas with existing, or high potential for, extensive public use and visibility are preferred.

Rationale: Greater public visibility will generate more effective public education and stewardship.

Coordination with other projects (for example, confined disposal or maintenance dredging).

Guideline: Sites involved in projects that obtain major advantages by coordinating with other projects will be given special consideration.

Rationale: Coordination with other projects can provide important cost savings, for example, in permitting activities and in expanding the size of a project.

Weighting and scoring

The Panel has used a weighting and scoring system to assign relative priorities to the sediment remediation criteria and projects.

Under this system, the first step was assigning a numerical weight to each criterion. Seven sediment remediation criteria each received a numerical weight of 1 to 5, with 5 meaning "highest priority" and 1 meaning "lowest priority." The weights assigned to the criteria are as follows:

High (5)	Contaminated sediment present (high toxicity).
	Control of combined sewer overflows, storm drains, industrial input and recontamination from adjacent sediment is adequate to prevent recontamination.
Medium (3)	Potential for addressing injury to target species/fish.
	Potential to incorporate extra habitat improvement, or proximity to other habitat projects or sediment remediation sites.
	Potential for human health risk.
	High potential for public education.
	Coordination with other projects (for example, confined disposal or maintenance dredging).
Low (1)	No criteria fit this category.

Four additional criteria originally established by the Panel were not weighted for the following reasons:

Proximity to City or Metro combined sewer overflow or storm drain. Since this criterion is a consent decree requirement, it would not help in determining the priority of projects.

Site ownership. This criterion would have been based on public versus private ownership. It does not appear that the type of ownership will influence a project's feasibility or ease of implementation.

Cost-effectiveness. Cost-effectiveness cannot be determined for projects at this early stage of the Program.

Opportunity. As with cost-effectiveness, opportunity cannot be determined for projects this early in the process. However, this criterion will be used with several other factors in the final stage of project selection. These other factors are discussed after the project list below.

Scoring how well each project met each criterion was the next step in the weighting and scoring process. Based on a different numbering system, a project received a "high" score of 3 for a specific criterion if the match was very good, a "medium" score of 2 if the match was okay and a "low" score of 1 if it the match was poor.

The final step was determining the overall priority of the projects. For each project, the weighting of each criterion was multiplied by the score assigned to each project for how well the project met the criterion. The resulting numbers for the criteria were added together to determine an aggregate score for each project. Based on these scores, the projects were divided into three groups with about the same number of projects in each group: high priority, medium priority and low priority.

Table 1 shows the results of this weighting and scoring process. Certain restrictions or changed conditions could result in a site receiving a higher or lower priority in the future.

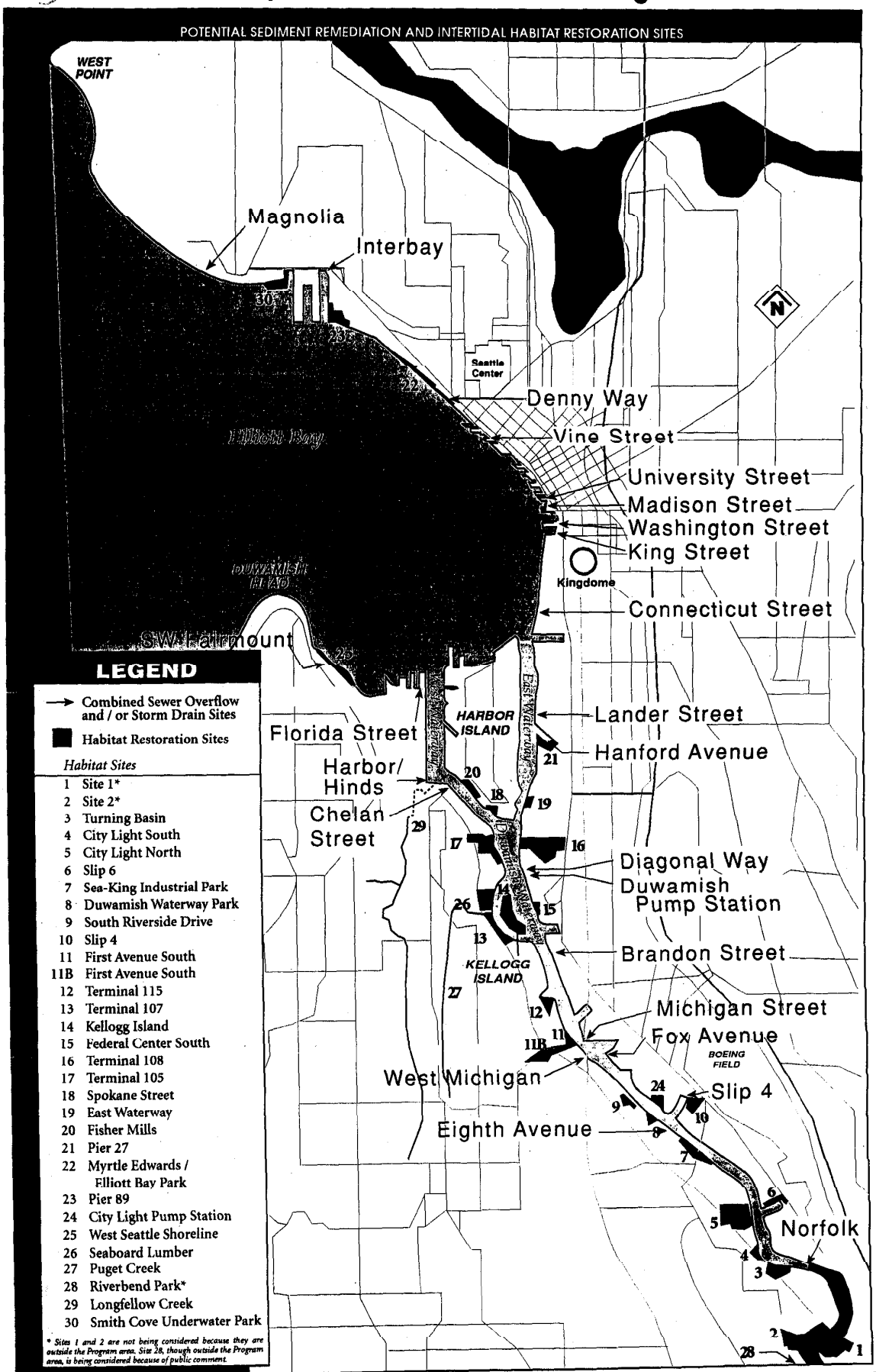
Resulting project inventory

The following is a list of potential sediment cleanup sites, listed in the order of priority that resulted from the screening process described above. These sites are identified by project name in Figure 5. The site descriptions include the use of the terms Sediment Quality Standards (SQS), Cleanup Screening Levels (CSL) and Minimum Cleanup Levels (MCUL). A short definition of these terms is provided in the glossary. Detailed definitions are available in the state sediment management standards, WAC 173-204.

Madison Street. Small-volume combined sewer overflow (less than 1 million gallons per year) controlled to no more than one discharge per year with separate stormwater discharge. This intertidal outfall is located at the base of the seawall between Pier 53 and

5

Elliott Bay / Duwamish Restoration Program



Pier 54. A 4.5-acre pilot sediment capping and enhanced natural recovery project was undertaken in 1992 to isolate areas of elevated chemical levels offshore from Pier 53-55. However, sediment near the shore and under the piers still contains levels of metals and some PAHs above Cleanup Screening Levels. Several other compounds, including PCBs, were below Cleanup Screening Levels, but above Sediment Quality Standards.

Washington Street. Small-volume combined sewer overflow (less than 1 million gallons per year) controlled to no more than one discharge per year with separate storm drain discharge. This intertidal outfall is located at the base of the seawall on the north side of Pier 48. A 4-acre sediment capping project was conducted north of the site in 1989 when the Washington State Department of Transportation expanded the ferry terminal on the south side of Pier 52. The sediment just south of the ferry terminal project remains at levels somewhat above Cleanup Screening Levels for mercury, silver, PCBs and some PAHs. Several other compounds, including lead and other PAHs, were below Cleanup Screening Levels, but above Sediment Quality Standards.

West Michigan. Small-volume combined sewer overflow (2 million gallons per year) with an intertidal discharge on the west riverbank north of the First Avenue South bridge. Flow volume is estimated to be reduced to 0.7 million gallons per year by 2006. Some PAHs and phthalates have been measured above Cleanup Screening Levels in sediment samples near this outfall. Several other PAH compounds were below Cleanup Screening Levels, but above Sediment Quality Standards.

Diagonal Way. Large-volume combined sewer overflow/storm drain (68 million gallons per year). Combined sewer overflow reduction was completed in 1993. Low flow diversion structures were installed in the new storm drain system; low stormwater flows were diverted to the Metro system for treatment. A shoreline outfall structure is located on the east bank of the Duwamish River across from the north end of Kellogg Island. Sediment near this outfall and the Duwamish Pump Station exceeds Cleanup Screening Levels for mercury, silver and phthalates. Several other compounds, including lead, PCBs and some PAHs, were below Cleanup Screening Levels, but above Sediment Quality Standards.

Florida Street. Storm drain with large intertidal outfall discharging into the west side of the West Waterway at the south end of the Lockheed property. The outfall line was previously cleaned of contaminated sediment. Sediment in the area near the outfall exceeds state Cleanup Screening Levels for cadmium, mercury, phthalates and some PAHs. Several other compounds, including other PAHs, PCBs and phenols, were below Cleanup Screening Levels, but above Sediment Quality Standards. The highest concentrations are frequently located mid-channel and may be related to other sources in the area rather than to the storm drain.

Duwamish Pump Station. A large combined sewer overflow volume (130 million gallons per year) has been predicted for this pump station site. However, measurement of wet-well elevations suggests no overflows occurred in 1991 or 1992. Flow monitors are being installed at overflow weirs in 1993 to verify the flow volumes directly. The

submerged outfall pipe is located across from Kellogg Island on the east bank of the Duwamish River, less that 200 feet upstream of the Diagonal Way outfall. Contamination at this outfall is similar to that measured at the Diagonal Way outfall. These areas would likely be cleaned up together.

Denny Way. Largest-volume combined sewer overflow discharging into Elliott Bay (300-600 million gallons per year), with a shoreline outfall located at Myrtle Edwards Park. A 3-acre sediment capping project was undertaken in 1990 to isolate a large offshore area with high chemical levels. Areas near the shoreline are still contaminated well above Cleanup Screening Levels for metals, some PAHs, phthalates and PCBs. Further remediation can occur when the flows from the combined sewer overflow are reduced. Flow reduction is scheduled for 1999 or sooner.

University Street. Small-volume combined sewer overflow and storm drain outfall (less than 3 million gallons per year) controlled to no more than one discharge per year. This intertidal outfall is located at the base of the seawall at the slip north of Pier 56. Sediment in the slip exceeds Cleanup Screening Levels for four metals: cadmium, lead, mercury and zinc. Low-flow diversion structures were incorporated into the storm separation system.

Slip 4. Two stormwater outfalls, plus an outfall from the discontinued Georgetown steam plant, discharge into the upper end of Slip 4. Sediment samples collected in Slip 4 show elevations of mercury and PCBs above Cleanup Screening Levels.

Vine Street. Small-volume combined sewer overflow (less than 4 million gallons per year). This intertidal outfall at the base of the seawall north of Pier 68 discharges into the northern end of the waterfront. Concentrations of cadmium, mercury, zinc and phenol are somewhat elevated above Cleanup Screening Levels in sediment near this outfall.

Interbay. Small-volume combined sewer overflow/storm drain with intertidal discharge into the upper end of the slip on the east side of Pier 90. This site is controlled to no more than one overflow per year. The sediment exceeds Cleanup Screening Levels for 4-methylphenol and is adjacent to a Port of Seattle habitat mitigation area.

Magnolia. Small-volume combined sewer overflow at the foot of Magnolia bluff and west of Pier 91. This outfall has been controlled to no more than one overflow per year. All sediment samples collected offshore of the outfall were below Sediment Quality Standards. Therefore, though this outfall was originally considered a possible remediation site, it may not need to be cleaned up.

Southwest Fairmount. Small-volume combined sewer overflow with a submerged outfall offshore from Seacrest Park. A creek discharges through the outfall. Several samples have been collected in the creek and near the mouth of the outfall. These samples did not exceed any Sediment Quality Standards. However, there is contamination offshore in this area. The contamination is believed to be from historical pier activities.

Harbor/ Hinds. One large combined sewer overflow (Harbor — 55 million gallons per year) and one small combined sewer overflow (Hinds — 11 million gallons per year) discharge through a single intertidal outfall located in the southwest corner of the West Waterway. Some flow reduction has occurred because of improved computerized control of wastewater storage in sewer pipes during storms. Longfellow Creek also drains through this discharge structure. By the end of 1993, Hinds will have been reduced to the state standard of no more than one overflow per year. In recent sampling, concentrations of some phthalates and phenols were found somewhat above Cleanup Screening Levels. Several other compounds, including mercury, other phthalates, PCBs and phenol, were below Cleanup Screening Levels, but above Sediment Quality Standards. Contamination at this site may also be attributed to other sources in the area.

Hanford Avenue. Large-volume combined sewer overflow (92 million gallons per year) with a submerged outfall along the east bank of the East Waterway. Flow reduction was completed as part of the Lander Street Separation Project in 1992, which reduced flow from 680 million gallons per year to 92 million gallons per year. Achievement of the goal of no more than one discharge per year is scheduled for after 2006. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. No recent samples have been collected near this outfall, but other areas of the East Waterway are contaminated with cadmium, mercury, tributyltin, phenols, phthalates and PCBs.

Norfolk. Small-volume combined sewer overflow (4 million gallons per year) with a shoreline discharge on the east riverbank, upstream of the upper navigation turning basin. Flow volume is estimated to be reduced to 1 million gallons per year by 2006. Concentrations of chlorinated benzenes, phthalates, PCBs, PAHs and mercury exceeded state Cleanup Screening Levels in a single sample collected directly at the outfall. Other samples collected near the outfall were relatively clean.

Michigan Street. Large-volume combined sewer overflow (250 million gallons per year) with a shoreline discharge on the east riverbank. The outfall, which is north of the First Avenue South Bridge, discharges behind a row of boat houses. Flow reduction is scheduled for completion in 2003. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. PCBs and some phthalates were measured at levels above Cleanup Screening Levels near this outfall. Several other compounds, including PAHs, were below Cleanup Screening Levels, but above Sediment Quality Standards.

Lander Street. Large-volume combined sewer overflow (215 million gallons per year) with a submerged outfall along the east bank of the East Waterway. Stormwater separation, completed in 1992, reduced the flow volume to an estimated 126 million gallons per year. Achievement of the goal of no more than one discharge per year is scheduled for after 2006. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. Mercury was found in sediment at concentrations somewhat above Cleanup Screening Levels. Several other compounds, including a PAH, phthalate and PCBs, were below

Cleanup Screening Levels, but above Sediment Quality Standards. These compounds found near this outfall are similar to other areas of the East Waterway.

Brandon Street. Medium-volume combined sewer overflow (25 million gallons per year) with a shoreline discharge located on the east bank of the Duwamish River. Flow reduction to one event per year is scheduled for completion by 2003. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. Mercury, PAHs, PCBs and phthalates found in sediment near this outfall exceeded Cleanup Screening Levels at moderate to high levels.

King Street. Large-volume combined sewer overflow (70 million gallons per year) with an intertidal discharge underneath the north end of Pier 47. Flow reduction to one event per year is scheduled for completion by 2006. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. The area near this outfall has the most contaminated sediment among the sites evaluated along the waterfront, with concentrations moderately to highly exceeding Cleanup Screening Levels for a wide variety of metals, PAHs and PCBs.

Fox Avenue. Small-volume combined sewer overflow and storm drain with a tributary area of 26 acres. The combined sewer overflow was controlled to no more than one event per year in 1976, but no flow data is available. The outfall is located under former shipyard piers south of Slip 3. Just before reaching the outfall, the pipe crosses a former shipyard previously owned and operated by Marine Power and Equipment. Sediment samples taken from manholes and catch basins when the shipyard was in operation displayed characteristics of sandblast material used at the site. The samples, however, were well above Cleanup Screening Levels for several metals. Marine Power and Equipment entered into a consent decree with EPA and Ecology that required best management practices to prevent the discharge of sandblast materials to the waterway. Marine Power and Equipment has since filed a Chapter 11, and the site is presently being used for some barge-loading activities.

Eighth Avenue. Small-volume combined sewer overflow (15 million gallons per year) with an intertidal outfall on the west riverbank across from Slip 4. Flow volume is estimated to be reduced to about 8 million gallons per year by 2006. Recent sediment sampling near this outfall did not show evidence of contamination above Sediment Quality Standards. However, a previous investigation found PCB contamination in this general area.

Chelan Street. Small-volume combined sewer overflow (estimated 4 million gallons per year) with a submerged outfall in the southeast corner of the West Waterway. Flow volume is estimated to be reduced from 24 million gallons per year to 4 million gallons per year. Levels of cadmium and phenol were measured in sediment near this outfall somewhat above Cleanup Screening Levels.

Connecticut Street. Large-volume combined sewer overflow (90 million gallons per year) with a submerged outfall discharging into the southeast corner of Elliott Bay. Flow reduction to one-half volume is scheduled for completion by 2006, with the goal of one

discharge per year thereafter. This schedule is subject to change, pending completion of Metro's Combined Sewer Overflow Control Plan Five-Year Update in spring 1994. Only one sample has been collected near this outfall. The sample did not show evidence of contamination above Sediment Quality Standards.

Site and project selection

To complete the selection of projects, the Sediment Remediation Technical Working Group will evaluate potential sites in the order they were ranked and consider other factors that currently support or argue against proceeding with each project. These factors include:

- potential for recontamination from other sources
- source control schedule
- potential for the project to be carried out by different sponsors
- opportunity for partial funding by another party
- availability of capping material and/or disposal sites.

Following final project selection, the working group will proceed with more specific planning and implementation. Using additional site and project-specific factors, the group will select projects to implement.

For each project, the following activities will be undertaken:

- characterize existing site conditions
- choose sediment remediation approaches
- establish an approximate project schedule
- establish cleanup standards and project success criteria
- develop a monitoring plan
- conduct an environmental review and obtain permits
- implement the project
- evaluate project success and use the results to modify future projects.

More information on each of these steps is provided below.

Characterizing existing site conditions

The Panel will characterize existing conditions at the sites selected for sediment remediation. Characterization will include compiling physical, chemical, biological and other relevant information from existing documents and conducting on-site surveys or studies. The results of the characterization will help guide project design and serve as a baseline for evaluating project success.

On-site studies will include two types of field investigation. In some cases, a preliminary site evaluation study may be conducted to answer important questions about a proposed project before a detailed site characterization study is conducted for that project. One example of a preliminary evaluation study is a waterfront recontamination study that Ecology will be conducting on behalf of the Panel. Because many of the potential waterfront sites were ranked "high" for site selection, the Panel has expressed interest in cleaning up at least one site along the waterfront. However, recent studies have indicated there is a potential for sites that have been cleaned up along the waterfront to become recontaminated over time. Because site cleanups are costly and temporarily disturb the environment, it may not be an efficient use of public funds to clean up an area that might soon be recontaminated. The specific rate of recontamination and the sources of recontamination to the waterfront are not currently known, although they may include ongoing sources and/or migration of contaminated sediment from other areas. The Waterfront Recontamination Study will take place over a period of one year, beginning in October 1993. Preliminary conclusions on the rate and sources of recontamination and the feasibility of cleanup along the waterfront will be available in January 1995. If the study shows that cleanup can be conducted successfully, the Panel will proceed with selecting a proposed waterfront cleanup site or sites and conducting a detailed site characterization study.

A detailed site characterization study will be conducted for each sediment remediation project selected for cleanup. Under this study, the selected site will be further characterized to clearly establish the boundaries, types and levels of contamination present at the site. The extent of the study at each site will be determined by how much information already exists, the size of the site, the complexity of the site and the remediation actions that are being considered. Site-specific field studies may include chemical analysis of surface and/or core sediment samples, bioassays or benthic evaluations, and physical characterization of sediment, as appropriate. These studies are a requirement of the state sediment management standards and for open-water sediment disposal and will be used to determine the areas and volumes of sediment requiring remediation, the feasibility of various remediation action alternatives and the potential cost of cleanup. These studies will also provide baseline information for evaluating environmental impacts and human health risks, if any, and for assessing the success of cleanup.

Alternatives and their consequences

This section describes different alternatives the Panel could use for sediment remediation projects. It also generally discusses each alternative's potential environmental consequences, many of which will be beneficial. Alternatives and their consequences will receive more detailed discussion in the environmental assessments prepared for individual projects.

No-action alternative

Under this alternative, the Panel would not undertake any sediment remediation projects. Only sediment remediation efforts that are not part of the Program would take place. While the court-ordered obligations agreed to under the consent decree make this alternative unlikely, it may be useful to consider the no-action alternative as site-specific options are evaluated. No action also constitutes a baseline against which the action alternatives can be compared. This alternative will be discussed in the environmental assessment for each project.

If the no-action alternative were adopted, the consequence would be that sediment remediation efforts in Elliott Bay and the lower Duwamish River would continue under the existing programs described at the beginning of this chapter. The Program would not add to or otherwise modify the focus of these efforts. This approach might mean that sediment remediation would not take place in some areas or that some areas would not receive the same type or extent of remediation as they might have under the Program.

Action alternatives

In-water remediation

Capping. Capping is a sediment remediation technique in which an area of contaminated sediment is covered by clean sediment to isolate the contaminated sediment from the marine environment. The clean sediment is usually dredged, brought to the capping site by barge and then spread over the contaminated area in a layer three feet thick. The cap is monitored for several years after placement to determine its effectiveness. Two capping projects have been carried out in Elliott Bay in the past few years: one off the Denny Way combined sewer overflow outfall and the other at Piers 53-55.

The primary environmental consequences of capping would be beneficial: contaminated sediment would be isolated from the marine environment and prevented from further affecting the water, marine life and people; capping would prevent the resuspension and dispersion of contaminated sediment in the water; and a new, cleaner habitat for marine life would replace the contaminated sediment. In the short run, organisms occupying the contaminated sediment would be eliminated, but they would be replaced relatively quickly by the greater number and variety of organisms that would make up the resulting healthier biological community.

As for the potentially adverse consequences of capping, contaminants might leach upward into the cap, thus increasing the amount of contaminated sediment. These contaminants, however, would be at lower overall concentrations than they were before the cap was introduced. In addition, the upward movement of contaminants might combine with cap migration, which would result in expansion of the contaminated area and potentially adverse effects on sediment-dwelling and marine life. Even if a cap did not migrate, a larger cap could temporarily eliminate a local food source for aquatic organisms because cap placement would temporarily eliminate benthic organisms from the affected area. In addition, when the sediment type for the cap is different from the native sediment it can result in a change in the composition and type of benthic organisms. Finally, a cap could interfere with navigation in some areas unless the cap placement is planned to avoid this. A site cleanup plan would provide additional detail concerning the potential for interference with navigation and commerce.

Enhanced natural recovery. Enhanced natural recovery is a type of capping in which only a thin layer of about one foot of clean sediment is placed over the contaminated area. This alternative might be used when a thicker cap might interfere with navigation, cap placement in areas such as piers would be difficult or natural sedimentation is very slow.

A primary benefit of enhanced natural recovery would be that it could allow for quick sediment remediation in areas, such as under piers, where it is difficult to implement other methods or where a large area must be capped to stop the resuspension of contaminated sediment. Other beneficial consequences of this alternative could include quicker recolonization of the cap than might occur with a thicker cap. With a thinner cap, some of the larger organisms underneath the cap might be able to move upward and occupy the new sediment. However, the fact that most organisms cannot survive burial by more than 10 centimeters of sediment may lessen the possibility of this type of recolonization. This alternative might also accelerate biodegradation of toxicants if they are mixed with the cap's clean materials by biological activity. If this mixing occurs, the clean material would dilute the toxicants in much the same manner as natural sedimentation would during natural recovery. The other beneficial environmental consequences of this alternative would be similar to those of capping.

The potential adverse environmental consequences of enhanced natural recovery would be similar to those of capping. In some circumstances, because of the thinner layer of clean sediment, the consequences could be greater.

Confined aquatic disposal. Confined aquatic disposal would involve dredging contaminated sediment, placing it in a depression on the floor of a water body and then covering it with a clean layer of sediment. In some cases, this method would require excavating a depression in the floor of the water body. The Duwamish West Waterway Confined Aquatic Disposal Project, completed in 1984, is one confined aquatic disposal project that has been carried out in the Program area. Another similar project — the One Tree Marina project — was carried out in southern Puget Sound.

This dredging and capping alternative would have many of the same beneficial and adverse environmental consequences as capping. An additional potentially adverse consequence would be that the resuspension and dispersal of contaminated sediment in the water would likely be greater under this alternative than under the other alternatives. In other words, dredging sediment out of the water at one location and then depositing it back into the water at a new marine location increases the potential for dispersion twofold. Dealing with the problems of dispersion and assuring accurate coverage of contaminated material are much smaller issues for shallow sites as compared with deeper sites, such as the Navy Home Port Project in Everett.

Bioremediation. Bioremediation is a technique in which bacteria are allowed to break down toxic chemicals into a nontoxic waste product. This approach is applicable only under special circumstances and for some organic chemicals that can be metabolized by bacteria. It is not applicable to metals because they do not break down. Currently, bioremediation is being used on upland sites. It has limited application for marine sites. Because bioremediation requires ideal conditions for success, there are only a few places where it is feasible. This method is considered experimental.

The consequences of this alternative would mainly be beneficial it would reduce sediment toxicity. A potentially adverse consequence of using an upland site could be the escape of contaminants during transport or from the confinement site. The escape of contaminants could adversely affect terrestrial organisms on the ground or in groundwater. In addition, because there are limited sites for land disposal of any material, use of upland sites for this type of sediment disposal would reduce the amount of land available for other types of disposal.

Out-of-water remediation

All the out-of-water sediment remediation alternatives involve dredging. The alternatives differ in the manner of disposal or cleanup of the dredged contaminated sediment.

Dredging and disposal of contaminated sediment in a confined area. With this alternative, contaminated sediment would be disposed of at one of three types of facilities: a hazardous waste landfill, an upland confined disposal area or a nearshore confined disposal area. Disposal at each type of facility is described below. Disposal at a sanitary landfill is not being considered because these landfills do not accept hazardous materials. To dispose of contaminated sediment at a hazardous waste landfill, the project sponsor has to meet the landfill requirements, which include dewatering, using specified handling procedures, placing the sediment in special containers, maintaining particular types of records, and testing.

Disposal at an upland confined disposal area involves the same basic steps as disposal at a hazardous waste confined disposal area.

Disposal at a nearshore confined disposal area involves first getting approval to use the area as a confined disposal site. Following approval, the project can begin construction,

first by surrounding the area with a berm. The contaminated sediment can then be dredged and placed in the enclosed area below groundwater depth to ensure the contaminants stay bound to the sediment in a wet state. Finally, the contaminated sediment is covered with clean material to the top of the berm.

Beneficial environmental consequences of this alternative would be the removal of contaminated sediment from the marine environment, thus eliminating further adverse effects this sediment might have on marine organisms. A potentially adverse consequence of dredging would be that contaminants might be resuspended in the water, the water then might disperse them, and the contaminants might affect other areas. Another potential consequence would be the escape of contaminants during dewatering, transport or from confinement. This escape of contaminants would adversely affect terrestrial organisms on the ground or in groundwater. In addition, because there are limited sites for land disposal of any material, the use of upland sites for this type of sediment disposal would reduce the amount of land available for other types of disposal.

Dredging and bioremediation on land, then redepositing. This approach would require that the contaminated sediment be placed in a confined area or container on land and then subjected to organisms, such as oil-consuming bacteria, that digest and render the toxicants harmless. This process would take place in a digester or reactor vessel. Once cleaned in this manner, the sediment would be returned to its original location.

This alternative would have the same beneficial consequences as the preceding one. It would also have the same potential for contaminant resuspension and dispersal through dredging. Since they would be cleaned rather than just stored, the contaminants might have less potential for adverse effects on land and when they are redeposited.

Dredging and physically or chemically cleaning sediment on land, then redepositing clean material and disposing of contaminated material or residue. As with bioremediation, this alternative first places the contaminated sediment in a confined area on land. One or more physical and/or chemical techniques, including screening, washing and/or applying detergents or chelating agents, are used to clean the sediment. The sediment is then returned to its original location.

This alternative would have the same environmental consequences as the preceding one. In addition, washing would generate a large volume of contaminated water that would have to be treated. Similarly, techniques using other cleaning methods could generate contaminated solvents or fine material that would require treatment and/or disposal.

Excavating contaminated sediment and replacing it with clean sediment. This approach would primarily be used in intertidal or shallow-water areas (generally less than 10 feet in depth) where it would be desirable to maintain existing water depths to preserve or enhance organisms important to the food chain. The removed sediment would be disposed of in one of the ways described above.

The environmental consequences of this alternative would be most similar to those of capping. A potential adverse consequence would be contaminant resuspension and

dispersal in the water column caused by dredging. Removal of the contaminated sediment would eliminate its adverse impacts on the underwater site. However, these impacts might be transferred to the sediment disposal site. Adverse impacts at the disposal site could include the escape of contaminants during transport or from confinement. This escape of contaminants would adversely affect terrestrial organisms on the ground or in groundwater. In addition, because there are limited sites for land disposal of any material, the use of upland sites for this type of sediment disposal would reduce the amount of land available for other types of disposal.

New technologies for contaminated sediment disposal

The cleanup of contaminated marine sediment is a relatively new development in engineering and science. Environmental laws, such as Superfund, that mandate the cleanup of toxic waste sites have created a market for new technologies to handle and dispose of contaminated sediment permanently. Laboratories worldwide are working on the problem, but development and testing of new technologies take time. Many promising technologies have not been fully tested or may have limited application. Some possibilities are listed below.

Sediment-washing. Sediment-washing is a mechanical technique that separates contaminated material in sediment from cleaner, contaminant-free sediment. The process, which involves screening and scrubbing the sediment, has two end products. The first is clean sediment, which can be placed in the original location or elsewhere as clean fill. The second product is a much-reduced volume of contaminated material. This method has been used to remove metals, petroleum residues and organic pollutants.

The advantage of this method would be the significant reduction in the ultimate disposal costs of contaminated material. Although it has been used successfully in Europe, the method has not been used in the Puget Sound area. The U.S. Army Corps of Engineers has recently conducted a test of this method in Michigan's Saginaw River. Its applicability and cost-effectiveness have yet to be considered.

Sediment-recycling. Contaminated dredged material can potentially be recycled in a variety of applications that will either destroy the contaminants, permanently render them unavailable for degradation or return them to more appropriate use. The potential for reuse depends on the type of contamination and composition of the sediment. An experimental example could be the incorporation of sediment contaminated with petroleum products into a material designed to contain petroleum products, such as asphalt for paving. Another example could be the addition of sediment to the limestone and clay material used to manufacture portland cement.

Incineration. Incineration has been widely used for degrading organic contaminants. Incineration can be a technically difficult operation because the complete destruction of contaminated material may be difficult to achieve. EPA sets standards for the operation of hazardous-material incinerators. These standards limit emissions and regulate process efficiency. In May 1993, EPA declared a moratorium on new incineration operations

while it addresses some problems with the process and the regulatory oversight program. Incineration remains highly controversial with the general public.

Time frame/implementation schedule

The Sediment Remediation Technical Working Group's evaluation of the project-specific factors described above will provide a general time frame and schedule for each project selected for implementation. The group will adjust timing and schedule as necessary during planning and implementation. To provide a general sense of anticipated project steps and the time they may require, a generic schedule for a "typical" project is presented in Table 2.

Success criteria and monitoring

The working group will establish success criteria and develop a monitoring program for each selected project. At the least, the success criteria will include low potential for recontamination, lack of cap movement or erosion (if capping is chosen), lack of contaminant movement and reestablishment of a healthy ecosystem. Other project-specific criteria may be added.

Each project will be monitored before, during and after cleanup. Monitoring techniques used during cleanup will vary according to the remediation method used and characteristics of the site. For capping projects, the capped area could be staked for later measurement of cap depth, for example. Other techniques will be used for dredging projects so the amount of sediment resuspended in the water column can be monitored. While the duration of post-cleanup monitoring will be site-specific, it should cover five to 10 or more years.

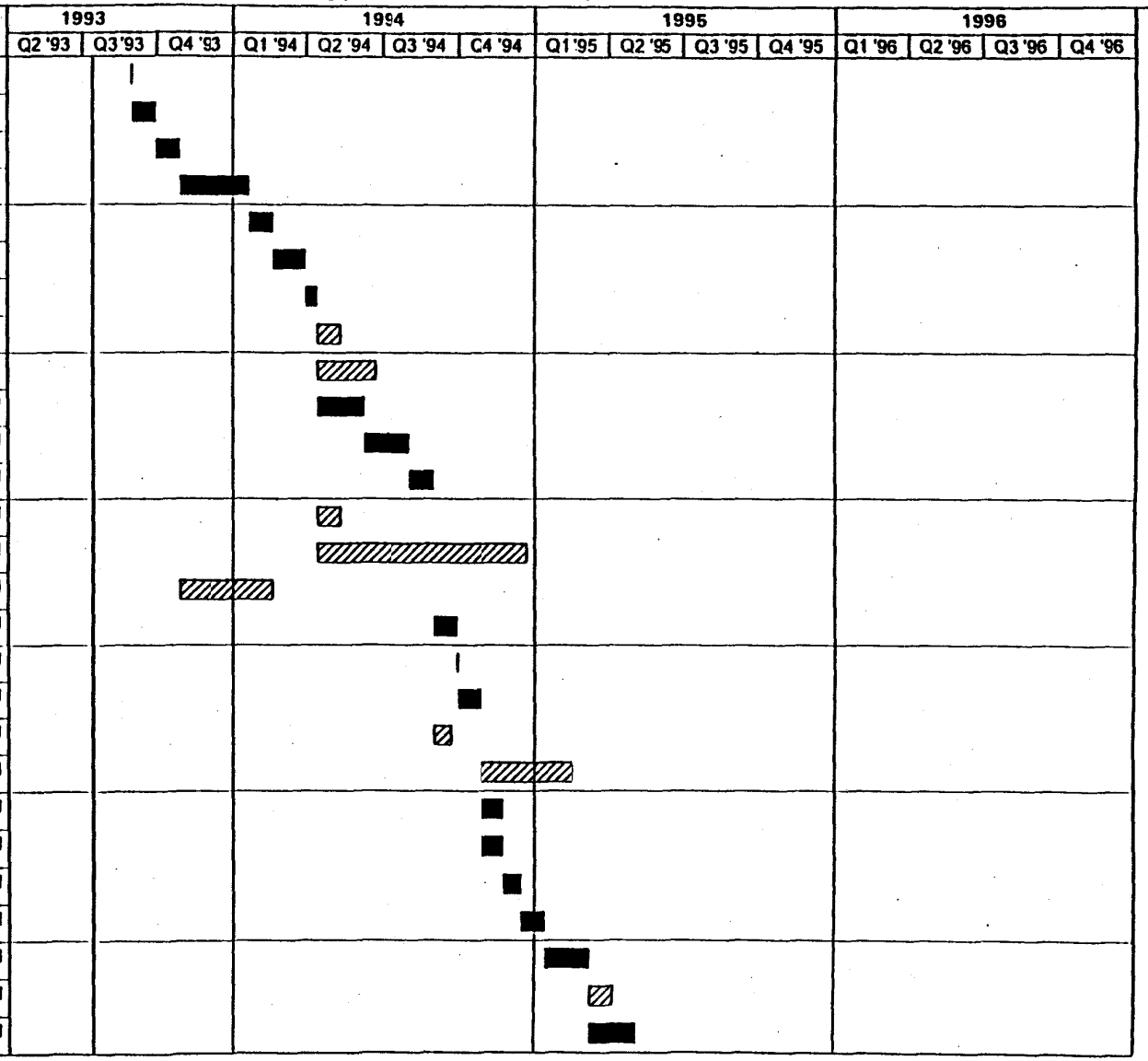
Post-cleanup monitoring could involve techniques such as grab-sampling, videotaping, observation and sampling of benthic flora and fauna, and sediment core-sampling. Other techniques might also be used to investigate potential bioaccumulation of toxic chemicals in marine organisms.

A 10-year monitoring program for the Pier 53-55 Sediment Remediation Pilot Project has been under way for more than a year. The program includes the following activities:

- surface sediment grab-sampling to monitor for recontamination
- sediment core-sampling through the cap to check for contaminant migration
- benthic taxonomy and video surveys to monitor recolonization of benthic organisms.

Table 2: Typical Sediment Project

ID	Name	Duration
1	select project	1d
2	agency lead	20d
3	develop scope for site invest.	20d
4	Select consultant	60d
5	negotiate consultant contract	20d
6	develop project workplans	30d
7	Panel review	10d
8	independent review	20d
9	Ecology review and revisions	50d
10	field work	40d
11	laboratory analysis and QA	40d
12	write data evaluation	20d
13	develop clean up method alt	20d
14	DNR/prop. owner discussion	181d
15	identify disposal site	80d
16	recommend preferred alts	20d
17	Draft Cleanup Study report	1d
18	Panel review	20d
19	SEPA/NEPA document prep	15d
20	Permit-MUP	80d
21	agency and Ecology review	20d
22	SEPA/NEPA public comment	20d
23	revise report and SEPA/NEP	15d
24	Panel review and revision	20d
25	Ecology Cleanup Action Dec	40d
26	public comment on decision	20d
27	preliminary design	40d



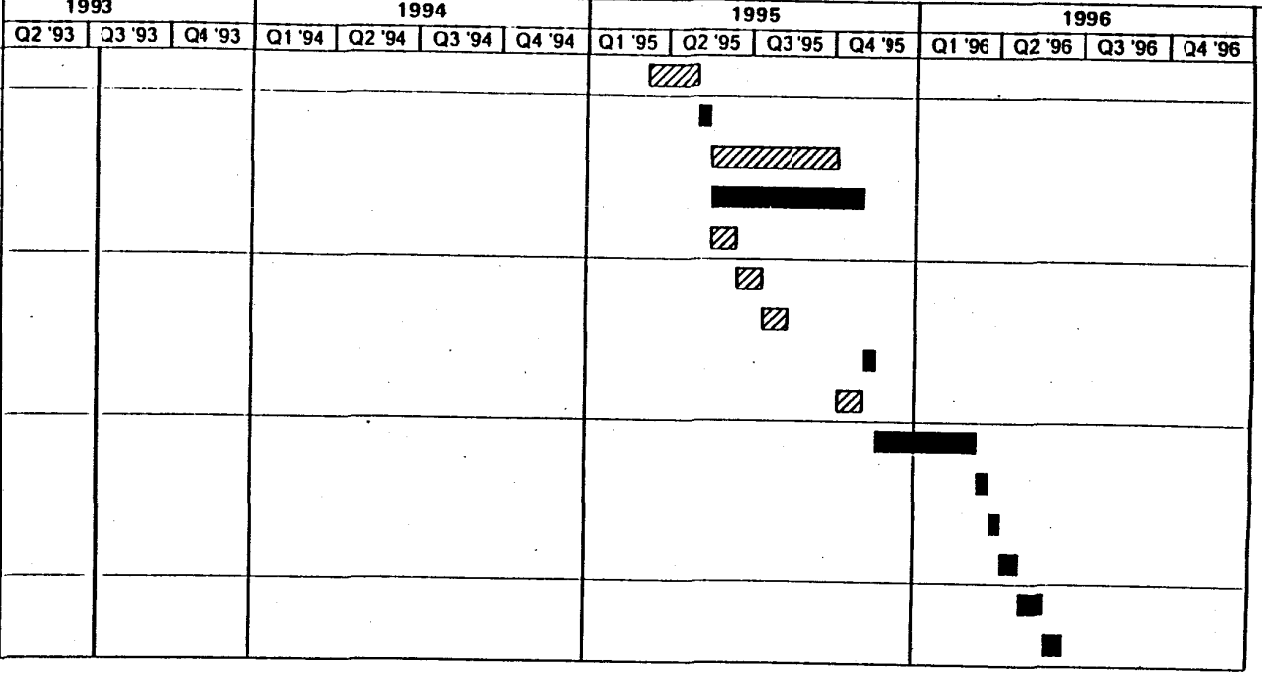
Project: Typical Sediment Project
Date: 7/12/93

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

Page 1

Table 2: Typical Sediment Project

ID	Name	Duration
28	disposal testing if required	40d
29	Panel review	10d
30	City shoreline permit process	100d
31	Negotiate with DNR/landown	120d
32	plans, specifications, &estima	20d
33	Panel review	20d
34	public comment	20d
35	Revise P,S, & E	10d
36	State shoreline permit	20d
37	Section 404, et al	80d
38	revise P,S, & E	10d
39	Panel review	10d
40	advertise for construction	15d
41	evaluate bids	20d
42	constructon start	15d



Project: Typical Sediment Project
Date: 7/12/93

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

Agency permits and approvals

After the environmental review described in Chapter 1 and as selected projects proceed through design and construction, various permits and approvals will be required by federal, state and local governments. The following list of potential permits needed for sediment remediation projects, while not all inclusive, is intended to provide information on additional opportunities for comment:

- **Federal** — work in navigable waters; discharge of dredge and fill material
- **State** — hydraulic project approval; cleanup action decision; water quality certification; authorization for use of state-owned aquatic land
- **Local (City of Seattle, City of Tukwila or King County)** — master use; building; grading; drainage; shoreline.

A more complete list of potentially applicable permits is provided in an Ecology publication, "Commonly Required Environmental Permits for Washington State," September 1990.

Sediment remediation project relationship to other Program elements

When sediment remediation projects are selected, the need for additional source control will be evaluated. If additional source control is found to be necessary, specific new source control measures will be identified and carried out. It may also be possible to carry out habitat improvement in conjunction with some sediment remediation projects.

4. Habitat Development

To maximize the Program's effectiveness, the Habitat Development Technical Working Group has been systematically evaluating the Program area to identify habitat development project opportunities that would best achieve the Program's goals. The evaluations have been carried out through a structured project identification and screening process. This process has involved developing criteria that reflect Program goals, prioritizing the criteria, identifying potential projects and evaluating these projects against the criteria. This process is described in detail below. A list of the identified projects follows the detailed description.

The Panel has also identified steps for completing project selection, implementing projects and assessing project success. These steps include selecting specific sites, selecting approaches to projects from applicable alternatives, estimating project schedules, identifying project success criteria, conducting post-implementation monitoring and determining the relationship of each project to other Program elements. These steps are discussed below.

To provide background and context, this chapter begins with a description of other government programs.

Other government programs

In recent years, several governments and agencies have made efforts to protect and enhance habitat in the Elliott Bay/Duwamish Restoration Program area. Many of these efforts are ongoing, with plans for continuation as funding allows. This section gives a brief overview of these efforts. In addition to the programs described below, the ongoing programs described for sediment remediation in the Chapter 3 and for source control in Chapter 5 also contribute to habitat enhancement by cleaning up benthic habitat and controlling or minimizing exposure to pollution.

Intergovernmental — Coastal America Partnership. The Coastal America Partnership was created to join federal agencies with tribal, state, local and private alliances in collaboratively addressing environmental problems along the nation's shorelines. In particular, the Coastal America Partnership focuses on the loss and degradation of habitat, pollution from nonpoint sources, and contaminated sediment. Through this partnership, NOAA's National Marine Fisheries Service, U.S. Fish and Wildlife Service, EPA, the U.S. Army Corps of Engineers, the U.S. General Services Administration and the Port of Seattle are implementing three pilot intertidal habitat restoration and enhancement projects in the Duwamish River estuary: Federal Center South, the Turning Basin and Terminal 105. These projects serve as the initial

implementation of a systemwide approach to restoration efforts in this estuary, with the specific objective of demonstrating creative approaches to restoring estuarine function in an urban environment. These projects can be viewed as pilot projects to guide habitat development activities.

Environmental Protection Agency — Puget Sound Management Plan. The Puget Sound Management Plan (Puget Sound Water Quality Authority, 1991) was adopted by EPA as the nation's first Comprehensive Conservation and Management Plan (CCMP) under the National Estuary Program. The Puget Sound plan identifies pilot restoration projects as a critical first step in the development of a long-term wetland restoration strategy for Puget Sound.

Environmental Protection Agency — Restoration programs. EPA and the Port of Seattle jointly funded an inventory and analysis of potential restoration sites in the Duwamish River estuary (Tanner, 1991). These agencies viewed this inventory and analysis as an important step toward developing and implementing an estuary-wide habitat restoration and mitigation approach.

Environmental Protection Agency — Estuarine Habitat Restoration Monitoring Protocol. EPA's Office of Coastal Water funded the development of this approach to quantitative assessment of restoration project habitat function (Simenstad et al., 1991). Use of the protocol on habitat restoration projects is intended to help ensure that adequate measures are used for measuring project success. It should also help expand the data base of available information on these projects, leading to a greater understanding of restoration techniques.

U.S. Army Corps of Engineers — Beneficial use studies. The Corps' Seattle District is investigating opportunities for the beneficial uses of dredged materials. The district has also supported sediment-testing at restoration sites in conjunction with sampling undertaken as part of maintenance dredging activities in the Duwamish Waterway. Testing and sampling have included sediment analysis at a potential restoration site in the waterway's upper turning basin. This cooperative effort between the Corps and EPA included a $9,000 contribution from EPA's Environmental Evaluation Branch for analysis of restoration site sediment samples.

U.S. Fish and Wildlife Service — Puget Sound Program. USFWS's Olympia Enhancement Office has initiated a Puget Sound Program. Fish and wildlife habitat restoration is an important element of this program, which is currently working with local sponsors on a variety of habitat projects. Some of these projects are taking place in the Duwamish River. In addition to in-kind support for technical assistance to local sponsors, this program has contributed about $60,000 for habitat restoration activities in Puget Sound since 1991.

Hatchery programs. Considerable resources are expended by the state Departments of Fisheries and Wildlife and other entities and private organizations on hatcheries in an attempt to sustain commercial and recreational fisheries in the Duwamish/Green River system. Combined hatchery programs plant about 7 million chinook, 1.5 million coho

and several hundred thousand steelhead fry annually in the Green River and other tributaries of the Duwamish River.

Port of Seattle. The Port of Seattle and Muckleshoot Indian Tribe have an agreement for funding habitat restoration and enhancement work in the Duwamish River. The funding is provided by a surcharge on mitigation work done by the Port. Both the Port and the Muckleshoot Indian Tribe draw on this funding for habitat projects. Thus far, only one project — construction of terraced slopes in the East Waterway — has been undertaken under this agreement. The Port is the local sponsor for Coastal America projects at the Duwamish River's turning basin and Terminal 105. The Port is involved in other habitat restoration projects through compensatory mitigation for Port development projects.

City of Seattle. The Seattle Department of Parks and Recreation has expressed interest in providing greater habitat amenities for its shorefront properties. In addition, the Seattle Engineering Department is investigating restoration options for its properties, which include many street rights-of-way with shoreline access. Staff from each of these city agencies has indicated interest in cooperating with federal agencies on Coastal America-sponsored intertidal habitat restoration projects. This cooperation might include providing property easements and in-kind services.

The City of Seattle also conducts the following habitat improvement programs:

- The Seattle Drainage and Wastewater Utility (DWU) sponsors a work crew from Seattle Conservation Corps every year to clean debris from creeks, build check dams to improve fish passage, provide public access to creeks and plant stream banks to reduce erosion and improve habitat.

- The City has adopted policies and regulations setting standards for development in environmentally critical areas. These policies and regulations include protection measures for wetlands and riparian systems.

Metro. Metro is enhancing shoreline habitat as part of the West Point Treatment Plant upgrade to secondary treatment and is funding several programs that involve habitat improvement in the Program area. Funding includes $25 million for the Shoreline Park Improvement Fund (SPIF) and $5 million for the Shoreline Improvement Fund (SIF).

Preliminary project identification

Over the past year, the Panel's Habitat Development Technical Working Group has been developing an approach for identifying and evaluating the options available for increasing habitat along Elliott Bay and the lower Duwamish River. Previous work (Tanner, 1991) had identified 24 potential intertidal habitat restoration sites along the bay and river shorelines. The working group started with these potential sites as a basis for evaluation and modified the list to better suit Program goals. The group has used a set of

goals and criteria to prioritize this list of potential sites. At a Panel-sponsored public meeting and separate workshop, the public was invited to nominate additional habitat sites that would be measured against the screening criteria. This section presents the goals, criteria and process used to prioritize the projects, lists the projects in the resulting order of priority and lays out the steps proposed to select and implement projects and measure their success.

Development of habitat goals

The philosophy of the working group has been one of attempting to restore natural systems within the Elliott Bay/Duwamish River system. Nearly 98 percent of the wetlands in this system has been lost to the detriment of a myriad of fish and wildlife species that rely on these habitats. While the Panel realizes it is not possible to return the system to a pristine condition, it believes that its habitat development projects will certainly restore some measure of lost habitat function. Restoring habitat is an important means of benefiting the fish and wildlife populations that have declined because of loss and degradation of these habitats.

To act on this philosophy and meet the overall goals of the Program, the working group developed the following set of goals specific to habitat development.

General goal

- Habitat development projects will be undertaken to benefit fish and wildlife species and the habitat attributes on which they depend. The overall goal of the Program will be a net gain of habitat function relative to current conditions in the Elliott Bay and Duwamish River estuarine system. It is recognized that the aquatic ecosystem of Elliott Bay and the Duwamish River estuary cannot be returned to a pristine condition; however, it is possible and desirable to provide increases in habitat quantity and quality. While a general objective of ecosystem recovery will be pursued, priority will be afforded projects or actions that benefit injured trust natural resources.

Specific goals

- Projects will be pursued to allow natural systems to provide habitat attributes that:
  - support the ecological processes characteristic of a healthy system
  - support a diversity of habitats and species historically indigenous to the area
  - are environmentally sustainable.

- To the greatest extent practicable, a landscape ecology approach to restoration will be pursued. This approach includes:
  - consideration of location within the estuary as it influences the habitat attributes of a site
  - connections with upland habitats.

- Opportunities for innovative design concepts and engineering techniques for habitat development will be investigated and, where appropriate, tested. The feasibility of pilot projects implementing these new ideas will be considered before application on a larger scale.

- Restoration projects will be monitored to evaluate their effectiveness in providing increases in habitat attributes. Results from project monitoring will be used to improve future project design.

- Projects will incorporate public involvement. The objectives are to:
  - incorporate public input into restoration decision-making
  - foster greater public understanding and appreciation of the habitat resources of Elliott Bay and the Duwamish River
  - encourage public participation in restoration project implementation and long-term stewardship.

- Public access at restoration sites should be guided by a concern for controlling disturbance and disruption of the sites.

Site assessment criteria

The working group has developed assessment criteria, which it has grouped into three categories of priority: high, medium and low. The criteria, by category, are as follows:

High-priority criteria

Size. Amount of potential restorable habitat area (subtidal, intertidal, riparian).

Guideline: Greater than two acres regarded as beneficial.

Rationale: Larger sites will allow for a greater heterogeneity of habitat attributes. It may be desirable to focus Program restoration activities on larger sites that would not be restored through other processes (that is, §404 mitigation, noncompensatory restoration).

Distance from contamination. Location of existing or potential sources of contaminants relative to the proposed restoration site.

Guideline: If a site contains contaminated sediment or is in a mixing zone of an ongoing source, it should be rated as disadvantaged.

Rationale: Restoration activities should not be undertaken at sites with a high risk of contaminating target organisms until sources are controlled or sites cleaned up.

Addresses injury. Extent to which restoration activities at a proposed site address injury to trust resources.

Guideline: Sites benefiting injured trust resources will be preferred.

Rationale: Priority should be placed upon activities that directly relate to species of concern under the Program consent decree.

Location. Physical location of potential restoration site within the estuarine system.

Guideline: If location of the site in the system ensures that the habitat will be utilized, the site should receive a higher rating than if this were not the case.

Rationale: Habitat types and their location within the estuary should be determined based on principles of landscape ecology.

Medium-priority criteria

Proximity to other habitats. Potential for target resources to utilize other habitats with connection to the potential restoration site.

Guideline: A surface-water connection to wetland or riparian habitats is considered beneficial.

Rationale: Potential restoration sites adjacent or proximate to existing habitat areas will provide greater habitat value. Sites that offer a potential connection to streams, riparian corridors or freshwater wetlands are especially important.

Adjacent land use (existing). Nature and condition of surrounding land use.

Guideline: Sites where existing land uses of adjacent properties do not have an adverse impact on aquatic resources are scored positively.

Rationale: Noise, bright lights or otherwise disturbing human activities and land uses may reduce habitat value and utilization of restoration sites.

Engineering cost/likelihood of success. Site attributes impacting cost and likelihood of success include elevation, currents/deposition, wave energy, existing habitat value, topography and shoreline condition.

Guideline: Sites where habitat restoration goals can be met with less change (for example, less earthwork, less engineering, less cost) and low maintenance should receive a positive score.

Rationale: Enhancing a site that already provides some beneficial habitat functions is regarded as more certain of success than creating habitat where none exists. The latter is also more expensive in most cases.

Proximity to public facilities. Extent to which potential restoration sites are "geographically and physically associated with existing public facilities, such as parks and fishing piers, in Elliott Bay and the Duwamish River" (Consent Decree, 1991).

Guideline: Meeting this condition established by the Program consent decree should result in a positive score.

Rationale: Consistency with the consent decree.

Low-priority criteria

Ownership. Fee-title owner(s) of potential restoration site.

Guideline: Public ownership is regarded as beneficial.

Rationale: It may be desirable to restore sites already in public ownership to avoid complex land purchases.

Public access. Physical ability of public to access or view the restoration site.

Guideline: Meeting this condition should result in a positive score.

Rationale: Sites that would accommodate nonintrusive public access might provide educational and recreational amenities while promoting long-term public stewardship.

Adjacent land use (potential). Potential land use includes consideration of such attributes as shoreline designation, zoning, comprehensive or project-specific planning (such as the Port of Seattle's container plan), etc.

Guideline: If potential land use would result in adverse impacts to aquatic resources targeted for restoration, the site should receive a negative score.

Rationale: Noise, bright lights or otherwise disturbing human activities and land uses may reduce habitat value and utilization of restoration sites.

Weighting and scoring

To establish the relative priority of habitat development criteria and projects, the Panel has used a weighting and scoring system similar to the one used for sediment remediation criteria and projects.

Under this system, the first step was assigning a numerical weight to each habitat development criterion. Criteria each received a numerical weight of 1 to 3, with 3 meaning "highest priority," 2 meaning "medium priority" and 1 meaning "lowest priority."

Assessing how well each project met each criterion was the next step in the weighting and scoring process. Based on a separate numbering system, a project received a "high" score of 3 for a specific criterion if the match was very good, a "medium" score of 2 if the match was okay and a "low" score of 1 if it the match was poor.

The final step was determining the overall priority of the projects. For each project, the weighting of each criterion was multiplied by the score assigned to each project for how well the project met the criterion. The resulting numbers for the criteria were added together to determine an aggregate score for each project. Based on these scores, the projects were divided into three groups with about the same number of projects in each group: high priority, medium priority and low priority. Projects within the same group, however, were not ranked in any order of priority.

Table 3 shows the results of this weighting and scoring process. Certain restrictions or changed conditions could result in a site receiving a higher or lower priority in the future.

Resulting project inventory

The following is a list of potential habitat development sites, listed in groupings of high, medium and low priority as a result of the screening process described above. No priorities have been assigned within the groupings. The locations of the sites are shown in Figure 5. Habitat sites 1, 2 and 15 are not being considered because sites 1 and 2 are south of the Duwamish Waterway turning basin and Site 15 (Federal Center South) is already being addressed under the Coastal America Partnership. Although outside the Program area, Site 28 (Riverbend Park) is being considered because of public comment. Figure 6 shows the Duwamish River tributaries in and beyond the Program area. Some of these tributaries are associated with the listed projects, as shown on Figure 5.

High-priority sites

Site 4: City Light South. This parcel abuts the south end of the Seattle City Light substation, between the river and West Marginal Way South, and is in the vicinity of Turning Basin Number 3. This site may be benefited from adjacent Hamm Creek and offers an opportunity to daylight the lower portion of this stream.

Additional Site Considerations

- City Light has no known plans for site development, and it is believed that the site is generally available for habitat development project work.
- King County Surface Water Management Division is working on addressing problems in the drainage basin of the South 96th Street storm drain. This

Table 3: Habitat Development

Potential Site Ranking
(By Category)

Site	Size (acres)	Distance from Contam.	Injury	Habitat Types	Prox. to Habitat	Land Use: Existing	Engr. Cost/ Success	Proximity to Public Facilities	Owner -ship	Public Access	Land Use: Potential	TOTAL RANKING SCORE
Site 4: City Light South	medium	medium	high	medium	medium	medium	high	medium	high	high	high	high
Site 5: City Light North	high	med/high	high	medium	high	high	low	medium	high	high	medium	high
Site 13: Terminal 107	high	medium	medium	low	high	high	medium	high	medium	high	medium	high
Site 14: Kellogg Island	high	medium	high	low/med	high	high	low	low	medium	high	high	high
Site 17: Terminal 105	high	low/med	med/high	low/med	high	medium	high	high	medium	high	low/med	high
Site 22: Myrtle Edwards	medium	medium	high	med/high	medium	high	medium	high	high	high	high	high
Site 23: Pier 89	medium	med/high	high	med/high	medium	med/high	low	high	low	high	med/high	high
Site 25: West Seattle Shore	medium	medium	med/high	low/med	medium	med/high	low	high	high	high	high	high
Site 26: Seaboard	high	medium	high	medium	high	med/high	medium	medium	low	medium	medium	high
Site 3: Turning Basin	medium	high	high	medium	med/high	low/med	medium	low	low	medium	medium	medium
Site 7: Sea King Ind. Park	medium	low/med	med/high	low	medium	low/med	high	low	low	low	high	medium
Site 8: Duwamish Park	low	medium	med/high	low/med	low	med/high	high	high	high	high	med/high	medium
Site 11: 1st Ave. S	medium	low	med/high	low/med	low	low	high	high	medium	high	low	medium
Site 11B: 1st Ave. S/509 marsh	high	low	medium	low/med	high	medium	medium	high	high	medium	low	medium
Site 16: Terminal 108	high	low	med/high	low/med	med/high	medium	medium	high	medium	low	low	medium
Site 18: Spokane St.	low	low	med/high	low	low	low/med	high	high	high	high	medium	medium
Site 27: Puget Creek	low	medium	low/med	medium	high	high	medium	low	low	high	medium	medium
Site 30: Smith Cove U/W Park	low	medium	high	low	low	medium	high	high	high	high	high	medium
Site 6: Slip 6	medium	low	med/high	low	medium	low/med	low	low	low	low	medium	low
Site 9: South Riverside	low	low	med/high	low/med	low	low/med	medium	medium	high	medium	low/med	low
Site 10: Slip 4	medium	low	high	medium	low	low	low	medium	low	medium	medium	low
Site 12: Terminal 115	low	medium	med/high	low	low	low	low	low	low	medium	medium	low
Site 19: East Waterway	low	low	med/high	low/med	low	low/med	low	high	medium	high	low	low
Site 20: Fisher Mills	low	low	med/high	low	low	low/med	medium	low	low	low	low	low
Site 21: Pier 27	medium	low/med	med/high	low/med	low	low	medium	low	low	low	low	low
Site 24: Pump Station	low	low	med/high	low/med	low	medium	low	medium	high	medium	medium	low
Site 28: Riverbend Park	medium	high	low	low	low	medium	low	low	low	high	medium	low
Site 29: Longfellow Creek		low	low	low	med-high	low		high	low	medium		

work will reduce nonpoint source pollution in the area and may afford opportunities for collaborative habitat work.

- Any changes in the course of Hamm Creek would require state Department of Fisheries approval.
- The size, shape and slope of the site may limit opportunities for intertidal habitat restoration.
- This portion of the Duwamish River, in the vicinity of the turning basin, is believed to be an area important to juvenile salmonid saltwater transition.
- The turning basin is at the upper end of the Duwamish Waterway and is, therefore, subjected to reduced vessel wake and problems associated with erosion of habitat sites.
- Other planned and/or potential habitat work in the turning basin would likely benefit and be benefited by work completed at this site.
- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail.

Site 5: City Light North. This parcel abuts the north end of the City Light substation, between the river and West Marginal Way South. Hamm Creek, the focus of restoration efforts by a local volunteer group, increases the potential habitat benefits this site affords. City Light North is the largest potential habitat development site identified and offers an opportunity for a combination of freshwater and tidal wetland restoration as well as stream and riparian corridor improvements for the lower reach of Hamm Creek.

Additional Site Considerations

- This site is currently being evaluated for a gas turbine generating facility and/or substation expansion by City Light. While these plans may make portions of the site unavailable for habitat development, it may also afford opportunities for cooperation in working on the site.
- King County Surface Water Management Division is working on addressing problems in the drainage basin of the South 96th Street storm drain. This work will reduce nonpoint source pollution in the area and may afford opportunities for collaborative habitat work.
- Any changes in the course of Hamm Creek would require state Department of Fisheries approval.
- Fill material at the site is likely composed primarily of clean sand dredged from the turning basin and may have beneficial uses.
- This portion of the Duwamish River, in the vicinity of the turning basin, is believed to be an area important to juvenile salmonid saltwater transition.
- The turning basin is at the upper end of the Duwamish Waterway and is, therefore, subjected to reduced vessel wake and problems associated with erosion of habitat sites.
- Other planned and/or potential habitat work in the turning basin would likely benefit and be benefited by work completed at this site.

- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail.

Site 13: Terminal 107. The Port of Seattle has set aside the shoreline area of T-107 and adjacent Kellogg Island for habitat purposes. At T-107, opportunities exist for debris removal, minor regrading and the establishment of a fringing marsh.

Additional Site Considerations

- The site is owned by the Port of Seattle. The Port has long-standing plans to undertake habitat restoration activities for future project mitigation. These plans by the Port would likely limit any opportunity for Panel-supported habitat development.
- This site adjoins what is perhaps the last remaining natural oxbow of the former Duwamish River channel.
- Nearby Puget Creek could be incorporated into the project, giving the site a connection to riparian habitat and freshwater wetlands and daylighting the lower portion of this stream. Puget Creek, which currently empties into a storm drain, originally emptied into the Duwamish River at this point. Reestablishing the creek's natural channel would be beneficial.
- Seaboard Lumber (Site 26) adjoins this site to the north. Opportunities exist for a collaborative project with the Port of Seattle that would benefit both sites.
- Options for habitat improvements at this site are limited by the shape and slope of the parcel.
- This site contains areas of known archaeological value.

Site 14: Kellogg Island. The southern portion of Kellogg Island has been raised to an elevation of 30 feet and higher with dredged materials. Return of the island to its former intertidal elevation and reestablishment of original salt marsh conditions have long been considered by the Port and various resource agencies. Northern portions of the island have retained much habitat value and were not considered for enhancement during site evaluation.

Additional Site Considerations

- The site is owned by the Port of Seattle. The Port has long-standing plans to undertake habitat restoration activities for future project mitigation. These plans by the Port would likely limit any opportunity for Panel-supported habitat development.
- Kellogg Island is large enough to support a mix of habitat types, ranging from forested uplands to intertidal mudflats and marsh. Adjacency of existing intertidal habitat would likely benefit any habitat development work undertaken here.

- Limited evidence suggests that some of the dredge material that would need to be excavated from Kellogg Island is contaminated.
- While the site is highly modified from its historic condition, the value of existing upland forested habitat is perceived as being high.

Site 17: Terminal 105. While creation of a tidal slough is planned for the northern portion of the Port of Seattle's T-105, additional enhancement and restoration could be pursued south of the Coastal America project work. Taken together, these projects have the potential to provide improved intertidal habitat along a relatively long portion of the Duwamish shoreline in the lower estuary.

Additional Site Considerations

- Work at this site would require cooperation of the Port of Seattle. While the Port has not finalized plans for this area, the site was acquired with the intention of industrial and/or commercial development. Upland development at the site might limit options for habitat development to a narrow strip along the shoreline.
- Historic use of the site may have contributed to suspected contaminant problems.
- The site is near Kellogg Island and may benefit from existing habitat in the vicinity.

Site 22: Myrtle Edwards/Elliott Bay Park. This long stretch of publicly-owned shoreline is dominated by large riprap boulders. Pocket beaches could be carved out of the steep shoreline, banks planted with trees and other vegetation, and kelp beds expanded in the adjacent subtidal areas.

Additional Site Considerations

- This site is one of only four currently being considered that offers opportunities for improvement of marine habitat.
- The Denny Way combined sewer overflow, a known source of contaminants, is upstream of most of this site. A source control program is being implemented for this combined sewer overflow, but completion of this program is several years away.
- Any intertidal or shoreline habitat improvements would likely require relocating an existing, heavily used bicycle/pedestrian path.
- Existing public use of this park is quite high, affording an excellent opportunity for public education and interpretation of habitat improvements.
- This site is in an area of high wave energy, making erosion control a significant issue.
- Habitat restoration proposals need to recognize fishing access and navigation and commerce uses in this area.

Site 23: Pier 89. An area just north of Elliott Bay Park in mixed ownership provides some opportunity for shoreline enhancement.

Additional Site Considerations

- Most of this site is currently under private ownership and would require acquisition prior to habitat development work.
- This site is one of only four currently being considered that offers opportunities for improvement of marine habitat.
- The size, shape and slope of the site may limit opportunities for intertidal habitat restoration and shoreline improvements.
- Any intertidal or shoreline habitat improvements would likely require relocating an existing, heavily used bicycle/pedestrian path.
- This site is in an area of high wave energy, making erosion control a significant issue.
- Habitat restoration proposals need to recognize navigation and commerce uses in this area.

Site 25: West Seattle Shoreline. The shoreline north and south of Seacrest Park could be diversified. Habitat development activities could be completed in conjunction with public access and interpretive displays.

Additional Site Considerations

- Recent Seattle Department of Parks and Recreation improvements along the shoreline will limit opportunities for habitat development work.
- Any intertidal or shoreline habitat improvements would likely require relocating an existing, heavily used bicycle/pedestrian path.
- This site is one of only four currently being considered that offer an opportunity for improvement of marine habitat. This site may be unique in its ability to support subtidal vegetation enhancement.
- Known sediment contaminant problems adjacent to the site should be remediated in conjunction with habitat improvements.
- The site is relatively isolated from industrial and marine cargo activities.
- This site is subject to seasonal storm damage, making erosion control a significant issue.
- This site is a popular scuba diving area. Divers represent potential advocates and long-term stewards of the site.
- Existing public use of this park is quite high, affording an excellent opportunity for public education and interpretation of habitat improvements.
- Habitat restoration proposals need to recognize navigation, commerce and fishing access uses in this area.

Site 26: Seaboard Lumber. Formerly the site of a large sawmill, this site is currently being considered for purchase by the Seattle Department of Parks and Recreation. Acquisition would include about 10 acres of submerged lands with important habitat value adjacent to Kellogg Island. Habitat restoration activities could be coordinated with development of a park at this site.

Additional Site Considerations

- This site has been given a high priority for acquisition under the Seattle Department of Parks and Recreation's Shoreline Park Improvement Fund (SPIF), affording an excellent opportunity for cooperation in developing the site. However, cooperation with the Parks Department on this site will require a decision by all parties in 1993.
- Development of this site may require an easement over a small portion of Port of Seattle property.
- This site adjoins what is perhaps the last remaining natural oxbow of the former Duwamish River channel. Purchase of the site and dedication to habitat development would likely protect this relic shoreline as well as adjacent intertidal and subtidal areas.
- Nearby Puget Creek could be incorporated into the project, giving the site a connection to riparian habitat and freshwater wetlands and daylighting the lower portion of this stream. Puget Creek currently empties into a storm drain.
- The site is near Kellogg Island and will benefit from existing habitat in the vicinity.
- Habitat development at the old Seaboard Lumber mill site will require extensive site cleanup and excavation of fill material.
- Adjacent property has known archaeological value.
- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail. The development of an education facility or learning center may be possible here.

Medium-priority sites

Site 3: Turning Basin. This site is located at the head of navigation on the Duwamish Waterway. Portions of the site are currently being restored by federal agencies and the Port of Seattle under the Coastal America Partnership. It is possible that the rest of the site may be restored by the Port at a later date.

Additional Site Considerations

- This site is owned by the Port of Seattle, and it is believed that the Port has long-term habitat development activities planned for the site that might preclude Panel involvement.
- Other planned and/or potential habitat work in the turning basin would likely benefit and be benefited by work completed at this site.
- This portion of the Duwamish River, in the vicinity of the turning basin, is believed to be an area important to juvenile salmonid saltwater transition.
- The turning basin is at the upper end of the Duwamish Waterway and is, therefore, subjected to reduced vessel wake and problems associated with erosion of habitat sites.

- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail.

Site 7: Sea-King Industrial Park. A narrow parcel adjacent to this warehouse development may offer the possibility for shoreline improvements at the top of the bank.

Additional Site Considerations

- This site is currently under private ownership and would require acquisition prior to habitat development activities.
- Slope and small site size significantly constrain habitat development opportunities.

Site 8: Duwamish Waterway Park. Riprap and eroding shoreline at this small City of Seattle park could be replaced with an expanded beach area and the establishment of a fringing marsh.

Additional Site Considerations

- This site is on the list of Seattle's SPIF sites, affording an opportunity for cooperation in developing the site.
- As one of very few sites in the middle portion of the Duwamish River currently being considered, the site represents an opportunity to establish a small pocket of habitat connecting upstream and downstream habitat development projects.
- Small site size significantly constrains habitat development opportunities.
- The South Park community represents a potential advocate and steward of this site.
- This site has significant potential for the development of education and interpretive facilities.

Site 11/11B: First Avenue South. Repairs and expansion of the First Avenue South bridge may afford opportunities for habitat improvement in adjacent shoreline areas. Slopes could be regraded and vegetation established in areas underneath or along the bridge and its approaches. Site 11B is an expanded project at this site, connecting an existing marsh, currently isolated from surface water features, to the Duwamish River.

Additional Site Considerations

- This site could be cooperatively developed with the Washington State Department of Transportation (DOT). With DOT cooperation, the Panel might realize a relatively large-scale habitat project for a modest investment.
- The project has the potential to provide a surface water connection to a marsh that is believed to be limited in habitat value by its isolated condition.
- This project involves complicated permitting issues and would require a high degree of agency cooperation.

- The value of habitat enhancement work under the First Avenue South bridge may be limited by high noise and low light levels.
- Known problems of groundwater contamination associated with this site would require further evaluation.

Site 16: Terminal 108. Portions of this site have been restored by the Port of Seattle. Additional excavation and shoreline enhancement activities remain possible at T-108.

Additional Site Considerations

- Because this site is owned by the Port of Seattle, habitat work here would require Port cooperation.
- This site is adjacent to the Diagonal Way/Duwamish combined sewer overflow, a known source of contaminants.
- Intertidal habitat enhancement could be compatible with existing uses of the shoreline at T-108.
- Current and/or potential habitat work in the vicinity would likely increase the value of habitat work completed at this site.
- Habitat work here could be combined with sediment remediation. Known sediment contamination problems adjacent to the site could be remediated in conjunction with habitat improvements.

Site 18: Spokane Street. An opportunity exists for relatively small-scale habitat work in association with landscaping planned under the new bridge.

Additional Site Considerations

- The Seattle Engineering Department is currently developing landscaping plans for the recently completed bridge work and has expressed interest in working with the Panel. With the potential for a modest investment by the Panel, intertidal habitat improvements could be coordinated with this planned work. Pursuing this project would require a decision as soon as possible in 1993.
- The site is one of a limited number of sites currently being considered near the mouth of the Duwamish River.
- Proximity to known areas of contamination could limit habitat benefits.
- Small site size significantly constrains habitat development opportunities.
- The value of habitat enhancement work under the Spokane Street bridge may be limited by high noise and low light levels.
- Boat wake from the adjacent West Waterway would make erosion a significant problem.

Site 27: Puget Creek. Puget Creek is a small low-flow perennial stream that drains the Puget Ridge area of West Seattle. About 0.6 miles of the creek flows through Puget Park and can be characterized as a largely natural riparian system. The lower portion of the creek flows into a storm drain before discharging to the Duwamish River at Idaho Street. Restoration would include daylighting of the lower reach and associated wetland restoration/creation.

Additional Site Considerations

- Most of the upper watershed is subject to residential development pressure. Water quality is threatened by sedimentation, nonpoint source pollution and other effects of poor source control and construction activities.
- A Local Improvement District petition for road construction through a riparian wetland, which serves as a tributary to the system, has been filed and could further adversely affect water quality and quantity.
- Known soil contamination from historical industrial activities near T-107 could limit restoration options.
- Citizen interest in Puget Creek represents potential stewardship role.
- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail.

Site 30: Smith Cove Underwater Park. This site is an existing underwater park in the vicinity of the Elliott Bay Marina and Terminal 91. Intertidal and subtidal areas have been restored and enhanced for mitigation purposes. Opportunities at this site are limited primarily to additional substrate enhancement.

Additional Site Considerations

- Intertidal areas are subject to high public use during low tide.
- This site has significant potential for the development of public access, education and interpretive facilities. The site could also be tied to the adjacent Duwamish bicycle trail.
- No additional expanse of aquatic habitat area is feasible at this site.

Low-priority sites

Site 6: Slip 6. Habitat restoration activities in this side channel off the Duwamish River might include raising the elevation of dredged areas by placing material in the water.

Site 9: South Riverside Drive. A street right-of-way adjacent to the Duwamish River in the South Park neighborhood, this site would benefit from debris removal and shoreline plantings.

Site 10: Slip 4. This side channel could offer opportunities for regrading adjacent upland as well as shoaling dredged subtidal areas. Habitat restoration here should not proceed until site contamination issues are addressed.

Site 12: Terminal 115. A small "cove" north of the Port of Seattle's T-115 properties might present opportunities for expansion and intertidal area improvements.

Site 19: East Waterway. Intertidal "mounds" created in the waterway for mitigation and adjacent shoreline areas would benefit from habitat enhancement.

Site 20: Fisher Mills. If fill material in an area currently used for parking adjacent to the West Waterway were excavated, the site could be regraded to an intertidal elevation.

Site 21: Pier 27. Pier 27 contains a slip adjacent to the East Waterway, the majority of which is no longer used. Cut-and-fill activities here could significantly expand and improve intertidal habitat.

Site 24: City Light Pump Station. This site, formerly the pump station for the old Georgetown steam plant, is still in public ownership. Fill material and retaining walls could be removed to increase intertidal area. and interpretive materials could be developed in conjunction with the old structure.

Site 28: Riverbend Park. While upstream of the Turning Basin, this site was evaluated by the working group at the request of area residents. Separation from the Duwamish River by a major arterial prevents major aquatic habitat improvements, thus limiting the potential for Panel participation in this proposal.

Site 29: Longfellow Creek. Until the lower reaches of Longfellow Creek can be daylighted, the working group has been unable to develop a specific restoration project for evaluation using assessment criteria. The Port of Seattle is contemplating development activities in this area as part of its proposed Southwest Harbor development plans. Implementation of these plans by the Port may trigger future reevaluation of this site. Any future habitat development activities undertaken by the Panel should be consistent with the Longfellow Creek Watershed Action Plan (Seattle Engineering Department, 1993).

Site and project selection

After finalizing the ranking of potential sites using the criteria described above, the Habitat Development Technical Working Group will begin a process of site selection and project implementation. Sites ranking high in the evaluation will be closely examined for their ability to be completed in a timely manner and for their relationship to the Program as a whole. Crucial issues that will be considered in narrowing the focus to the three to five sites that can be completed with the available time and money include:

- willingness of the land owner to allow habitat development activities
- opportunity for partnerships with other parties, thus expanding the scope of the Program
- results of more detailed examination of site contamination and potential effects of proximate pollutant sources on habitat projects
- cost and engineering feasibility of project activities.

Following final site selection, the working group will proceed with more specific planning and implementation. Using additional site and project-specific factors, the group will develop projects.

For each project, the following activities will be conducted:

- characterize existing site conditions
- environmental audit
- choose habitat development approaches
- establish an approximate project schedule
- establish project success criteria
- develop a monitoring plan
- conduct an environmental review and obtain permits
- implement the project
- monitor project success and use the results to modify future projects.

More information on each of these steps is provided below.

Characterizing existing site conditions

The Panel will characterize existing conditions at the sites of selected projects. Characterization will include compiling physical, chemical, biological and other relevant information from existing documents and conducting on-site surveys or studies. The results of the characterization will help guide project design and serve as a baseline for evaluating project success.

Environmental audit

An environmental audit will be conducted if a property is going to be purchased. The focus of the environmental audit is to look for physical or chemical factors that would constrain the use of the property and result in liability to the owner. The audit will be conducted according to Ecology guidelines.

Alternatives and their consequences

This section describes different alternatives the Panel has considered for habitat development. It also generally discusses each alternative's potential environmental consequences, many of which will be beneficial. Alternatives and their consequences

will receive more detailed discussion in the environmental assessments prepared for individual projects.

The approach selected for specific projects could be a combination of elements from one or more of the action alternatives. The environmental consequences of all these alternatives would be the protection or enhancement of habitat and thus the encouragement of the growth or establishment of desired plant and animal species.

No-action alternative

Under this alternative, the Panel would not undertake any habitat development projects. Only habitat development efforts that are not part of the Program would take place. While the court-ordered obligations agreed to under the consent decree make this alternative unlikely (since it appears to be inconsistent with the intent of the consent decree), it may be useful to consider the no-action alternative as site-specific options are evaluated. No action also constitutes a baseline against which the action alternatives can be compared. This alternative will be discussed in the environmental assessment for each project.

The outcome of the no-action alternative would be continued reliance on the programs described for habitat restoration activities at the beginning of this chapter. Additional habitat restoration efforts would likely be limited to compensatory mitigation projects associated with industrial development. Sites being considered for habitat development under the Program might be developed for industrial purposes if restoration projects are not implemented. The Program would not add to or otherwise modify the focus of these efforts.

Action alternatives

Institutional/regulatory controls

Existing habitat preservation through increased institutional/regulatory controls would consist of one or more of a variety of potential regulatory mechanisms. To minimize habitat degradation, these mechanisms could include changes in local ordinances or zoning as well as modifications in federal and/or state regulations. This alternative might also involve working with private and public landowners to help them take steps to protect or enhance habitat on or adjoining their property. As this type of alternative would not directly result in an improvement of the status quo, the Panel would have to examine any institutional/regulatory proposal carefully to insure that it would be consistent with the Panel's goals and the intent of the consent decree.

Land purchase/preservation

Land purchase/preservation would preserve existing habitat through the purchase of property that has some habitat value. The land could be set aside for future habitat enhancement efforts or preserved in its current condition. As this type of alternative would not directly result in an improvement of the status quo, the Panel would have to

examine any land purchase/preservation proposal carefully to insure that it would be consistent with the Program's goals and the intent of the consent decree.

Habitat development

For most sites, a combination of habitat development approaches will probably be used. A brief discussion of the impacts associated with each approach is also provided, but is not intended to be comprehensive. Because of the site-specific nature of environmental impacts, a more detailed impact analysis is being reserved for the environmental assessments that will be prepared for each project.

Fill removal, regrading, excavation. Historically, the wetlands bordering the lower Duwamish River and the Seattle waterfront were drained and filled to create land suitable for agriculture, navigation and commerce, and urban development. The historical, meandering river channel was replaced by a dredged waterway, and the material was disposed of in adjacent intertidal wetlands. At the same time, the shoreline was reinforced with vertical bulkheads or large rocks (riprap) to prevent erosion. Restoration of intertidal habitat often requires removal of the fill and shoreline reinforcement and then regrading to create a more gradual slope characteristic of a natural shoreline. Depending on other factors, such as location in the estuary and site-specific characteristics, the created intertidal area may undergo additional restoration work so that a mudflat, beach or vegetated wetland can be created.

Positive impacts of fill removal include the creation of habitats that provide food, foraging and resting areas for juvenile salmonids and other fish, shore birds and other wildlife. Adverse impacts of fill removal may include temporary increases in erosion associated with land disturbance; transport and disposal impacts away from the project site, if the material on-site cannot be incorporated into project design; temporary construction noise; and increases in air pollution associated with construction equipment. In some cases as intertidal conditions are restored, vegetation and associated habitat benefits of upland areas may be lost.

Stream-daylighting. Freshwater streams draining to the Duwamish River are mostly hidden in culverts as the result of historical development practices. In some cases, enough of the original stream near its mouth remains above ground to make it feasible to restore the stream to the surface. Depending on existing development patterns, the route for a daylighted stream may not be its historical location. Under this approach, restored streams would be designed to be as natural in appearance and function as possible, providing meanders, riparian vegetation, gravel substrate, pools and riffles, and other characteristics of healthy streams.

Positive impacts of daylighting streams include the restoration of free-flowing streams that provide shelter and food for juvenile salmonids as well as spawning habitat for adult salmon. Adverse impacts of daylighting streams may include temporary increases in erosion associated with land disturbance; possible affects on adjacent land uses, such as road crossings, during construction; and construction-related increases in noise and air pollution.

Revegetation. Development along Elliott Bay and the Duwamish River replaced natural wetland vegetation with fill, buildings and pavement. Once fill is removed and an intertidal area and shoreline are regraded, completion of the habitat restoration project requires revegetation with native wetland and riparian plants. Revegetation by planting as opposed to natural seeding may be advisable to stabilize the area and promote desirable native species over invasive nonnative plants. Successful plant establishment depends on the creation of the appropriate hydrologic regime that favors desired plant species, and on the selection of plant species that suit the hydrologic regime and other site-specific factors. A debris control barrier, such as pilings and log booms, may be constructed to protect vegetation and wildlife habitat from floating debris and boat wakes.

Positive impacts of revegetation include soil stabilization and restoration of riparian buffers and intertidal vegetation, which provide shelter, shading and food for salmonids, shore birds and other wildlife. Adverse impacts may include loss of fishing access because a debris control barrier is used.

Substrate modification. Uniform shorelines, which are considered desirable for navigation, lack the diversity of features that provide habitat for aquatic life. In some cases, aquatic habitat function can be enhanced by modifications offshore. Possible habitat enhancements under this approach include increasing fine-grained mudflats; placement of boulders to promote the growth of macroalgae, such as kelp; and placement of oyster shell piles to provide artificial reefs for macroinvertebrates, such as juvenile crabs.

Positive impacts of substrate modification include increasing scarce habitat types that favor target species and providing substrate that increases the growth of food organisms. Adverse impacts may include temporary increases in turbidity during in-water construction and possible interference with navigation from the reduction in depths.

Change in water depth. The straightening and dredging of the Duwamish Waterway and the dredging of the mudflats at the river's mouth have resulted in an abundance of deep-water habitat and a lack of intertidal and shallow subtidal habitat. Restoration of shallow water habitats could be accomplished by placing fill in subtidal areas to obtain the desired depth. This restoration may be achieved in conjuction with fill removal from nearby uplands, provided the fill is not contaminated.

Beneficial impacts of changing water depth include the creation of additional intertidal and shallow subtidal habitat areas, which are among the most important habitats for production of food organisms preyed on by migratory salmon and resident fish. Adverse impacts may include temporary increases in turbidity during in-water construction and possible conflicts with navigation and fishing caused by reduced depths.

Removal of contaminants. Many areas along the shores of Elliott Bay and the Duwamish River have been contaminated with industrial chemicals as a result of the industrial uses that have been predominant along these shores. Habitat development projects may involve the cleanup of contaminated areas, both to comply with the state

Model Toxics Control Act and to ensure the contaminants do not adversely affect the organisms the projects are designed to benefit. Cleanup requirements apply to both upland and aquatic areas. More information on sediment cleanup is available in Chapter 3.

Positive impacts of site cleanup include increased habitat value and reduced risk to people, fish and wildlife from direct or indirect exposure to contaminants. Adverse impacts may include increased erosion from land disturbance, increased turbidity from soil erosion and from dredging and capping activity, and impacts associated with the removal, transport and disposal of contaminated material off-site.

Time frame/implementation schedule

The Habitat Development Technical Working Group's evaluation of the project-specific factors described above should provide a general time frame and schedule for each project selected for implementation. The group will adjust timing and schedule as necessary during planning and implementation. To provide a general sense of anticipated project steps and the time they may require, a generic schedule for a typical project is presented in Table 4.

Success criteria and monitoring

Various environmental surveys and assessment studies will be initiated before habitat development project planning and implementation. After projects are completed, it will be necessary to monitor them to evaluate the effectiveness of the restoration actions. Monitoring plans will need to be developed that address several important questions, including:

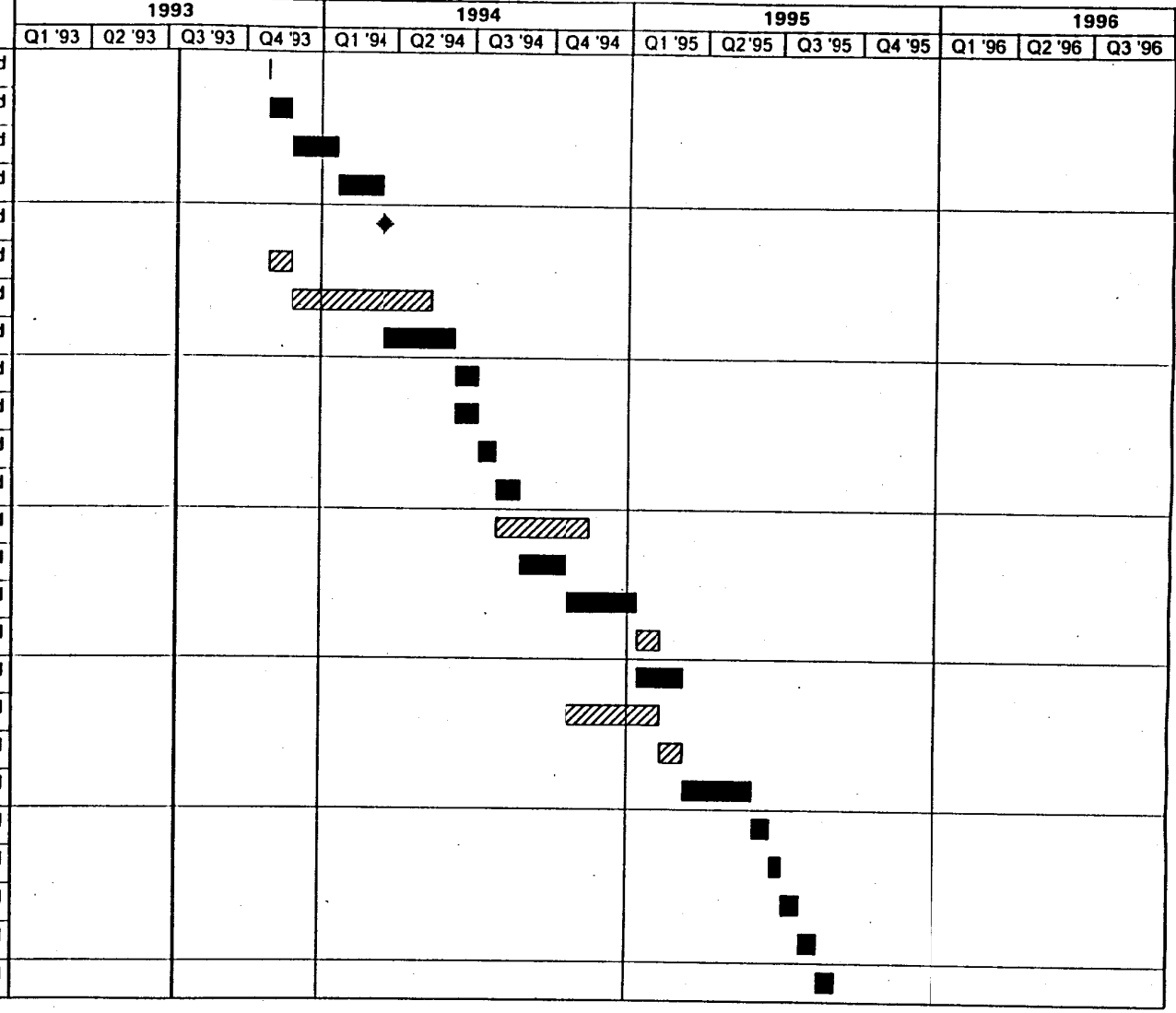
- Is the project achieving ecological goals and providing desired functions?
- Does the project fulfill the consent decree obligations of providing substitute resources?
- Does the project meet the conditions associated with required permits?
- Does the project meet the goal of limiting recontamination from other sources?

Careful project oversight may allow mid-course corrections to be made during the construction phase. Effective monitoring will assist in assessing project performance and prescribing post-construction improvements, if required.

The issue of monitoring remains largely unaddressed by the working group, although costs anticipated for this activity have been accounted for in the Program's long-range budget planning. The working group will need to develop a monitoring strategy that meets the above requirements while also being cost-effective. With limited Program

Table 4: Typical Habitat Project

ID	Name	Duration
1	panel site selection	1d
2	agency lead	20d
3	select site consultant	40d
4	site investigation	40d
5	good site go/no go decision	0d
6	appraisal	20d
7	negotiation with prop owner	120d
8	preliminary design	60d
9	Panel and agency review	20d
10	independent review	20d
11	revise preliminary plan	15d
12	SEPA/NEPA document prep	20d
13	Permit-MUP	80d
14	environment process	40d
15	final design	60d
16	panel and agency review	20d
17	complete final design	40d
18	shoreline permit	80d
19	shoreline state	20d
20	Section 404, et al	60d
21	revise final design	15d
22	Panel review	10d
23	advertise	15d
24	evaluate bids and award	15d
25	construction start	15d



Project: Typical Habitat Project
Date: 7/12/93

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

funds, the Panel will need to find a balance between the need for effective monitoring and the desire to maximize project work.

Three pilot restoration projects funded through the Coastal America Partnership process are using the monitoring approach described by the Estuarine Wetland Restoration Monitoring Protocol (Simenstad et al., 1991). This approach evaluates the attributes of restoration sites, quantifying the specific environmental characteristics — such as, food organisms, cover and nesting materials — that support fish and wildlife use. In addition to evaluation of completed restoration projects, Coastal America monitoring includes the study of two reference sites on the Duwamish River. Reference site data will be useful to the Habitat Development Technical Working Group in establishing performance standards for habitat development projects. Intertidal habitat attributes to be assessed at Coastal America restoration and reference sites include:

- emergent plant community (composition, coverage, biomass)
- sedentary infauna (species occurrence, density)
- active infauna
- sedentary fish
- surface epifauna
- target species (juvenile salmonids, shore birds, waterfowl)
- physical parameters (substrate, bathymetry, topography, sediment grain size, contaminants).

A quantitative monitoring approach is desirable because it provides necessary data on the important attributes of restoration sites. This data can be compared to other sites, both natural and restored, in an effort to gain increased understanding of the effectiveness of various approaches to habitat restoration and enhancement. The Protocol is gaining increased agency acceptance, and its use in the monitoring of Coastal America restoration sites may have established an important precedent in restoration project assessment. It is likely that the U.S. Fish and Wildlife Service, one of the four federal partners in Coastal America projects, will advocate continued use of the Protocol, including its application to Elliott Bay/Duwamish Restoration Program habitat development sites.

Agency permits and approvals

After the environmental review described in Chapter 1 and as selected projects proceed through design and construction, various permits and approvals will be required by federal, state and local governments. Potential permits needed for habitat development projects are the same as those discussed for sediment remediation in Chapter 3.

Habitat development project relationship to other Program elements

When habitat development projects are selected, the need for additional source control will be evaluated. If additional source control is found to be necessary, specific new source control measures will be identified and carried out. It may also be possible to carry out habitat improvement in conjunction with some sediment remediation projects.

5. Source Control

The Panel has been establishing source control goals to protect natural resources and prevent recontamination of sites selected for sediment remediation or habitat development in the area covered by the consent decree. In accordance with the consent decree, the Panel will review and comment on source control actions proposed by the City of Seattle and Metro to achieve the Panel's goals, determine if proposed actions are likely to achieve the Panel's goals and direct the City and Metro to take actions approved by the Panel.

The Panel's approach to source control is discussed below. This discussion focuses on a general overview of typical source control methods because specific source control measures cannot be identified until sediment remediation and habitat development projects are chosen.

To provide background and context, this chapter begins with a description of other government programs.

Other government programs

Since the 1960s, governments and agencies have carried out a number of programs to control the sources of pollution in the Elliott Bay/Duwamish Restoration Program area. Many of these programs are ongoing. This section gives a brief overview of these programs.

Metro. Metro is responsible for the collection, treatment and disposal of wastewater from local municipalities in the Program area. Metro conducts a source control program that involves identifying pollution sources and helping those responsible for those sources to reduce or eliminate the pollution they generate. Metro conducts an industrial waste program that regulates large dischargers to the collection system, a hazardous waste program that targets businesses discharging small quantities of hazardous waste, and a household hazardous waste education program. Finally, Metro undertakes projects to control combined sewer overflows.

City of Seattle. The Seattle Drainage and Wastewater Utility (DWU) addresses flooding problems and water pollution associated with stormwater runoff. This utility conducts a monitoring program to aid in controlling pollutants at their source. In cooperation with regulatory agencies, the City has developed a permitting program for storm drains and a

sampling program for storm drains and creeks. The utility's other source control programs include the following:

- *Longfellow Creek Watershed Action Plan and comprehensive drainage improvements*. DWU has completed an action plan for the control of nonpoint source pollution in this watershed. Under this Ecology-approved plan, the City has applied for grants to design and build a creek rehabilitation project and create a streamkeeper position. DWU has also provided water quality improvements and stormwater detention in the Delridge basin (Seattle Engineering Department, 1993).

- *Duwamish River Source Control Program*. Using an Ecology grant, DWU is conducting a three-year source control program for Elliott Bay and the Duwamish River. The program will improve the operation and maintenance of storm drains and facilitate cleaning and sampling efforts. Water quality inspectors will visit sites, investigate potential sources of pollution and provide information to businesses and property owners on best management practices for water quality protection.

- *Harbor Island Superfund Cleanup*. DWU entered into a voluntary agreement with EPA to clean the storm drain system on Harbor Island, conduct a detailed pollutant source-tracing investigation program and conduct long-term water quality monitoring of the storm drain system on the island. This work was completed in 1990.

- *South Park Water Quality Improvement*. DWU is currently designing a project in the South Park drainage basin to improve the quality of stormwater released into the Duwamish River. The program includes construction of detention facilities to treat stormwater, decrease sediment loadings and protect a wetland.

- *Duwamish River cleanup*. The Seattle Solid Waste Utility participates with community groups in annual cleanups along the Duwamish River and Longfellow Creek. The City hauls and disposes of trash collected by the volunteers.

- *Stormwater, Grading and Drainage Control Code*. This ordinance provides controls for new development and redevelopment. It includes updated provisions for stormwater detention, pollution prevention, erosion control and the use of water-quality best management practices.

- *Public outreach and education*. DWU has a program to educate citizens about their role in solving water quality problems.

- *Storm drain stenciling and motor oil recycling*. DWU operates storm drain stenciling and motor oil recycling programs.

The City also conducts an extensive combined sewer overflow control program. The city completed control of all its combined sewer overflows into Elliott Bay and the Duwamish River in 1992.

Elliott Bay Action Program. The Elliott Bay Action Team (EBAT) has been conducting source control inspection of industrial sites since its inception in 1985. Inspectors first focused their source control efforts on Harbor Island because of the superfund cleanup there. More recently, they have been inspecting facilities in the South 96th Street drainage area in preparation for planned drainage work by King County. In addition, they inspect facilities in other Elliott Bay/Duwamish drainages in response to complaints.

Ecology — National Pollutant Discharge Elimination System (NPDES). Under this program, Ecology issues permits for discharges to receiving waters from sources such as wastewater treatment plants, industries and stormwater. These permits limit the amount of pollution that discharges may contain. There are currently 17 industrial facilities that have active NPDES permits and discharge to the Duwamish River. Most of these discharges consist of noncontact cooling water or stormwater.

Ecology also administers new NPDES stormwater permit regulations, which require permits for the discharge of stormwater from most industrial sites. A baseline stormwater general permit (baseline permit) developed by Ecology will cover most industrial categories. In general terms, the stormwater permits require development and implementation of stormwater pollution prevention plans, which focus on implementation of best management practices. Activity at construction sites affecting more than five acres also requires coverage by the baseline permit.

The NPDES stormwater permit regulations also require cities and counties with an urbanized population of 100,000 or more to apply for an NPDES permit for discharges from their separate storm drainage systems. This requirement applies to both the City of Seattle and King County. The City and County have submitted their applications to Ecology. When issued, the stormwater permits will make cities and counties responsible for the quality of their discharges from storm drains. Because of the permit requirements, the City and County have adopted new drainage ordinances that give them enforcement authority over pollution discharges to their storm drainage systems.

Ecology — Resource Conservation and Recovery Act (RCRA) Program. This joint Ecology/EPA program regulates the generation, handling and disposal of hazardous wastes. Regulatory requirements under the program can include waste containment measures, material-handling requirements, groundwater monitoring and site cleanup.

Ecology — Pollution prevention. Pollution prevention is a major element of all Ecology programs. Ecology regulations include requirements for best management practices in stormwater and industrial waste discharge permits, for reduction of hazardous waste generation and hazardous substance use. for control of air emissions and for development of oil-spill prevention plans, to name a few. Ecology will be placing more emphasis on pollution prevention in the future.

Port of Seattle. The Port controls discharges from Port property by regulating the use of petroleum products, reducing pollution from these products, and studying and controlling storm drain discharges.

King County. King County has established a watershed planning program for the Green/Duwamish River basin in cooperation with Ecology. The program has identified nonpoint pollution programs, has worked to enhance intergovernmental coordination and is developing action plans for the areas of greatest pollution. These action plans will attempt to reduce nonpoint pollution from stormwater, livestock, on-site septic systems and other sources in the basin.

Seattle-King County Department of Public Health. The Seattle-King County Department of Public Health conducts three programs that may decrease pollution in the Elliott Bay/Duwamish Restoration Program area: a plan to educate businesses that generate small quantities of hazardous waste about state hazardous waste management priorities and solicit their cooperation, a "Hazards Line" to provide information on the proper disposal of hazardous materials, and a pamphlet to describe hazardous waste disposal regulations, proper recycling and disposal methods, and other information.

Alternatives and their consequences

This section describes different alternatives the Panel could use for source control projects. It also generally discusses each alternative's potential environmental consequences, many of which will be beneficial. Alternatives and their consequences will receive more detailed discussion in the environmental assessments prepared for individual projects.

The consent decree gives source control a different role than it gives sediment remediation and habitat development. Under the consent decree, the Panel must establish source control goals to protect natural resources and prevent recontamination of sediment remediation and habitat development project sites. Any source control efforts carried out under the Program must be linked to these sites. To meet the Panel's goals at these sites, the City of Seattle and Metro will determine what source control actions, if any, need to be taken beyond existing source control programs. Any additional source control actions will be subject to Panel review and approval. Thus, the level of new source control efforts associated with specific sediment remediation and habitat development projects will fall somewhere between no effort and substantial effort, depending on a variety of factors.

Since it cannot be known what source control alternatives might be used until specific sediment remediation and habitat development projects have been proposed, this section does not contain a detailed discussion of source control alternatives. However, typical source controls and their consequences are generally discussed below.

No-action alternative

Implementation of this alternative would mean that no source control efforts beyond those already planned or under way by the City of Seattle, Metro and other entities would take place. The consequences of this alternative would vary from site to site. Without associated source control efforts, a project site could be recontaminated with pollutants. Alternatively, source control may already be substantially achieved at a site, with no further pollutant impact expected from preventable combined sewer overflow and storm drain sources.

Action alternatives

Source control techniques that could be used under the Program include targeting industrial sources and assisting them with best management practices, such as recycling or disposing of waste products, to prevent the discharge of pollutants to the storm drain; increasing the maintenance of tributary sewer or storm drain systems; sampling, monitoring and inspecting sewerage systems upstream; and redirecting flows to Metro for treatment. Additional measures include monitoring the storm drainage system to locate sources of pollution and educating the public about keeping pollutants out of the drainage system. Although major combined sewer overflow control projects are essential for source control, the City of Seattle and Metro have separate ongoing programs. Metro's current combined sewer overflow control plan calls for 75 percent combined sewer overflow control by the year 2006. Selected outfalls could be addressed on an accelerated schedule to provide adequate source control sooner.

The consequences of these source control actions would be to reduce the amount of pollutants reaching and potentially harming natural resources in the Program area. The potential degree of reduction would vary from site to site.

Selection and implementation of source control

As Program projects are selected, the City of Seattle and/or Metro will review the status of pollutant discharges from their systems to the project sites. They will then investigate the need for additional source control efforts at each site. If investigation indicates the need for additional source control, either or both of these agencies will develop proposals for implementing controls and submit them to the Panel for approval. They will then carry out the proposals approved by the Panel.

Detailed Background, Organization and Process

Program background

Under the federal Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), the U.S. Department of Commerce and U.S. Department of the Interior are authorized to act as trustees for certain of the nation's natural resources. Under this law and under delegation from the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA) is the federal trustee for natural resources, including fisheries resources, associated with coastal and offshore waters of the United States. The Interior Department is the federal trustee for fish and wildlife. The law also authorizes the Muckleshoot Indian Tribe, the Suquamish Tribe and Washington state agencies, to be trustees for natural resources under their control. The law authorizes these trustees to assess and recover monetary damages for harm resulting from releases of hazardous substances to natural resources for which they are trustees.

On March 19, 1990, the United States filed suit on behalf of the National Oceanic and Atmospheric Administration against the City of Seattle and Metro to recover damages for alleged injury to natural resources in Elliott Bay and the lower Duwamish River. The suit described the injury as having been caused by the release of hazardous substances, particularly specific harmful metals and organic chemicals, from the City and Metro sewerage systems. The suit sought to recover damages in the form of the costs of assessing injury and of "restoring, replacing or acquiring the equivalent of the affected natural resources " (Consent Decree, 1991).

The City of Seattle and Metro maintain that effluent discharged from their combined sewer overflow and storm drain outfalls has presented little, if any, potential for injury to the natural resources in Elliott Bay and the Duwamish River; that their wastewater collection, treatment and disposal programs have contributed substantially to decreasing and/or minimizing injury and damage to natural resources; that their water quality programs have made improvements in the water quality of Elliott Bay and the Duwamish River; that their pretreatment programs, along with on-site monitoring, keep the contribution of industrial sources within permitted discharge limits; and that the limited natural resource injury from combined sewer overflow and storm drain outfalls appears to have originated equally from industrial, commercial and residential customers that discharge into the City and Metro systems (Consent Decree, 1991). In addition, before 1991 when sediment standards were adopted, there were no regulations pertaining to the quality of sediment near discharges.

Rather than go through a potentially long and costly legal process, the parties to the suit worked out an agreement by which they will work together to restore and replace the natural resources of Elliott Bay and the lower Duwamish River. The agreement is embodied in a September 1991 consent decree issued by the U.S. District Court, Western District of Washington. The main elements of the agreement include the following:

- The agreement will cover Elliott Bay and the lower Duwamish River up to the head of navigation.
- The parties to the suit will form a Panel of Managers to plan and direct projects with the assistance of technical advisory groups.
- The Panel will include the public in selecting and planning projects.
- The City and Metro will continue their existing pollution control programs.
- The Program conducted under the agreement will meet the following requirements for sediment remediation, habitat development and source control:

  Sediment Remediation
  - The City and Metro will jointly pay $12 million into a trust account over a six-year period, 1992-1997.
  - Projects will occur primarily around City and Metro combined sewer overflow and storm drain outfalls.
  - The Panel will use state sediment standards to determine the level of cleanup.

  Habitat Development
  - The City and Metro will jointly pay $5 million into the trust account over the same six-year period.
  - The City and Metro will jointly make available real estate valued at up to $5 million as sites for projects.
  - Projects will occur near parks and other public facilities when compatible with the habitat development goals.

  Source Control
  - The City and Metro will jointly make available up to $2 million in additional measures to control sources of pollution that could recontaminate the sites of sediment remediation and habitat development projects. These funds will be used where sources cannot be adequately controlled through existing programs.

Soon after the agreement was signed, the parties to the agreement began work on the Program, which they named the Elliott Bay/Duwamish Restoration Program.

Organization and process

Program organization

The parties to the consent decree are the U.S. Department of Commerce's National Oceanic and Atmospheric Administration, U.S. Department of the Interior (acting through the U.S. Fish and Wildlife Service), Washington State Department of Ecology (Ecology), Muckleshoot Indian Tribe, Suquamish Tribe, City of Seattle and Municipality of Metropolitan Seattle (Metro). These entities subsequently became the participants in the consent decree and thus the members of the Panel established to direct the Program created by the agreement. The role of all Panel members is to make sure the Program meets the legal obligation of restoring and replacing natural resources in the Program area — Elliott Bay and the lower Duwamish River — as specified in the consent decree. In addition, the City of Seattle and Metro also have the role of funding and providing real estate and in-kind services for the Program.

The consent decree gave the Panel the authority to direct the Program. This authority includes, among other things, establishing procedures; determining how project funding is to be spent within the consent decree framework; gathering data; planning and approving projects; establishing source control goals; reviewing, commenting on and approving proposals by the City of Seattle and Metro to meet the Panel's source control goals; providing information to other governments, agencies and the public; deciding which studies and projects are to be carried out; and establishing standards for and managing projects.

The Panel is assisted in its work by two technical working groups—one for sediment remediation and one for habitat development—and by a public participation committee. These subgroups consist of representatives of Panel member governments as well as representatives of other entities involved with Elliott Bay and lower Duwamish River natural resources (Consent Decree, 1991). The three subgroups establish goals; review, prioritize and recommend projects; collect and disseminate information; and address a variety of issues for their assigned areas. Proposals and recommendations developed by the subgroups must be approved by the full Panel before they can be implemented.

The process by which the Panel will meet the requirements of the consent decree is generally as follows:

- In scheduled increments from 1992 through 1997, the City of Seattle and Metro will provide $24 million for sediment remediation, habitat development and source control projects. Payments are in the form of direct funding, real estate and in-kind services.

- With the assistance of the technical working groups, the public and other concerned governments and agencies, the Panel will identify, review and

prioritize potential sediment remediation and habitat development projects as well as associated source control measures.

- The Panel will select for implementation those projects that best meet the consent decree requirements.
- The Panel will implement the selected projects, including finalizing project design, managing implementation and conducting post-project monitoring to measure success.

The preceding description is, of course, only a general overview of the Program's process. More detail on any aspect of this process is available from the Administrative Director at the phone number and address provided on the back of the title page of this document.

Environmental review process

Many federal programs and projects must meet the requirements of the National Environmental Policy Act (NEPA). In addition, most programs and projects sponsored or regulated by Washington state agencies must meet the requirements of the State Environmental Policy Act (SEPA). Since the Elliott Bay/Duwamish Restoration Program is both federally and state sponsored, it is subject to the requirements of both NEPA and SEPA. The way in which the Program will meet these requirements is discussed below.

NEPA requires federal agencies to evaluate the potential environmental impacts of their proposals. The Program will conduct this evaluation for each of its proposed projects through an environmental assessment (EA). NEPA specifies that EAs must include discussions on the need for a proposal, on alternatives to the recommended course of action or proposed project, and on the environmental impacts of the proposed action or project and its alternatives. Based on 40 CFR, §1508.9, EAs are required to provide sufficient evidence and analysis for an agency to determine whether to prepare an environmental impact statement (EIS) or a finding of no significant impact (FONSI).

To minimize duplication, SEPA allows state and local agencies to adopt the NEPA environmental review of a project to meet SEPA requirements. When a NEPA EA is prepared for a project, a state or local agency may adopt the EA to satisfy the SEPA threshold determination requirement [WAC 197-11-610(2)].

The Panel will follow this approach. An EA will be prepared for each selected project and will be adopted under SEPA. When the EA is completed, it will be made available for public comment for at least 30 days. The SEPA adoption of the EA may take place concurrently with the issuance of the EA so that a single comment period may be used to meet the requirements of both NEPA and SEPA. If the adoption takes place later, a second comment period might be provided to comply with SEPA.

To minimize redundancy, EAs for projects occurring later in the Program will be written under a tiering approach that builds on earlier EAs. The EAs on the first project for sediment remediation and habitat development will each lay the foundation for fully addressing all important environmental issues for their respective class of projects. EAs on subsequent projects will summarize the issues that were adequately addressed in earlier EAs, referring the reader to those EAs for details on these issues and then going into detail on any new issues or impacts of concern for the project at hand.

The public is being provided an opportunity to participate in the environmental review process for the Program through the public participation process described in Chapter 1. If an EA concludes that the environmental impacts of a project or a series of projects are likely to be significant, the Panel will likely either modify the project to reduce the impacts or select another project. If the benefits of the project appear to justify it, the Panel may decide to prepare an environmental impact statement to more fully evaluate the project's benefits, impacts and alternatives.

Permitting

When the environmental review process for a project is complete, the Panel will apply for the federal, state and local permits necessary to carry it out. Proposed projects will have to meet the requirements of all applicable laws and regulations in order to proceed. The public will have an opportunity to comment on the permit applications for each project by contacting the appropriate regulatory agencies.

Elliott Bay/Duwamish Restoration Program

February 10, 1993
Public Meeting

Comments Recorded on Flip Chart

- Minor sum of money for the scope of the project.
- Not aware of settlement previously. Is this a backdoor for industry to pay $24 million to continue polluting?
- How was the geographic scope defined? Why are only intertidal areas being considered for restoration/remediation?
- Cochairperson for Historical Duwamish was not notified of the meeting. Comments on the historical uses of the Duwamish River.
- The Duwamish Tribe is interested in more opportunities for involvement with the Panel's activities.
- Why don't the City of Seattle and Metro recover costs from industry?
- How does the Harbor Island cleanup fit in?
- Metro related pollution near West Point Treatment Plant should be addressed.
- Will habitat development plans near Seacrest Park address historical contamination from Seattle Steel slag and Wycoff? Will the sediment be cleaned up?
- How do areas of upland contamination figure into identified restoration plans?
- What were the criteria for the initial identification of potential habitat sites?
- How do you keep restored areas free from recontamination?

- What percent of outfall impact areas are being looked at for possible sediment remediation?
- Do any proposed projects have any effect on navigability?
- Are there any salmon spawning in Hamm Creek?
- Encourage adult salmon spawning in Hamm Creek through spawning habitat enhancement as part of restoration projects.
- How do you define biological success? How will sites be maintained to prevent invasion of nonnative species?
- Why is NOAA in current position in settlement Panel? Isn't NOAA's jurisdiction usually limited to marine areas?
- The proper designation of the Muckleshoots is "Muckleshoot Tribes." Muckleshoot refers to a group of tribes that live at the Muckleshoot reservation.
- What is the potential for making the Duwamish Tribe a party to the settlement agreement? This is their native land, and they want to help clean it up.
- Why is the scope limited to combined sewer overflow and storm drain outfall impact areas?
- Duwamish Tribe would like to see canoe landings at all restoration sites.
- Potential for contamination of restored habitats by sediment transport. Suggest phased approach: first, sediment; then, habitat.
- Specific answers are needed to important questions:
  - How contaminated are the fish people are eating, and what are the health effects?
  - Will fish staying in the river longer as a result of increased habitat also result in increased health risk?
- The $24 million should be evenly divided geographically.
- Harvesting of shellfish should be prohibited where not safe. The Panel should address health issues.

- Water quality in the Duwamish River needs to be addressed: the temperature is too high; the oxygen is too low.

- Blackfoot Tribe recognizes the Duwamish Tribe even though they are not recognized federally. The Duwamish Tribe should be included in Duwamish River cleanup efforts.

- There used to be fish in creeks in West Seattle. Would like to see restoration of Longfellow Creek and Schmitz Park Creek. Also, would like to see restoration of a creek that comes off Pigeon Hill near the north end of Kellogg Island.

- Do plans include transporting clean mud with living biomass to ensure food organisms colonize remediation sites?

- Should consider reintroduction of native Olympic oysters.

- Change Duwamish slough back into the Duwamish River. "Put the kinks back into it."

- Will repeat cleanups be necessary because of recontamination? More should be done to address source control.

- What is the cost-effectiveness of moving outfalls farther out into the bay, considering potential for recontamination of nearshore areas? For example, Denny Way combined sewer overflow.

April 14, 1993
Workshop

Comments Recorded on Flip Chart

- Need to address human health/safety at habitat development sites.
- Motorized boat ramp at Seaboard Lumber site (Option 1) not consistent with habitat goals.
- Need to consider existing habitat value at Kellogg Island.
- How many projects can you undertake for $5 million?
- What are the recommended project sites?
- Provide rationale for "size" as a high-priority criteria.
- Consider the value of several smaller projects in comparison to one or two large projects.
- Any potential habitat development sites in tributaries to the Duwamish River under consideration?
- Costs of projects seem high in comparison with those of Coastal America.
- Need to be more clear regarding your emphasis on intertidal habitat projects.
- Ducks/geese are a nuisance — people should stop feeding them. Don't let your habitat development projects compound the problem.
- Suggest that the distribution of effort be one-third Duwamish River, one-third inner Elliott Bay and one-third outer Elliott Bay.
- Linkages between concerns regarding restoration, consumption of shellfish and relocation of outfalls.

- Restoration of habitat can benefit and encourage sea cucumbers, dungeness crabs and oysters as well as clams. Consider eelgrass and vegetated kelp beds.
- Need to consider managed harvesting of shellfish as you pursue habitat development.
- Are other potentially responsible parties being pursued so that you can undertake additional projects?
- Public access as a criteria — is it a priority?
- What is the goal of habitat development?
- Which species are you trying to benefit?
- Don't restore with the idealized past in mind — consider the needs of species using the river presently.
- Maximization of value of habitat projects
- Overemphasis on the Duwamish River.
- Seek economies by using material removed from one site at another. Keep beneficial uses in mind.
- Disposal of dredged materials expensive.
- Which sites seem to be "one-time" opportunities?
- Try to duplicate habitat currently used by juvenile salmonids.
- T-107 should be developed at the same time as the Seaboard Lumber site.
- Any consideration of city property at Smith Cove? At Pier 91?
- Sedimentation rate — is it a potential problem at habitat sites?
- Upland restoration at T-108?
- Consider Wolf Bauer's work.
- Aquatic plants source?

- Suggest you use foliage available from city construction projects.
- Consider giving small amounts of funds to community groups for stream stewardship work.
- Suggest you get adjacent landowners involved in your projects.

April 21, 1993
Workshop

Comments Recorded on Flip Chart

- Metro/City source-control timing and goals.
- When will Metro reach the goal of one event per year?
- How does "control" reduce overflows?
- What is being done for storm drains and combined sewer overflows for which you are working toward a goal of one event per year compared with those for which you have yet to accomplish that goal?
- What happens with stormwater from overflows?
- What is being done to reduce nonpoint source inputs into storm drains?
- Do bioassays confirm sediment chemistry results?
- Sediment standards do not address risk.
- Please describe relationship/differences between Superfund activities and Panel activities.
- Do Metro/City face liability for sites not remediated under this settlement?
- Why isn't Sedrank being applied?
- How many sites can you work on for $12 million?
- How long will capping preclude human uses of sites?
- How will caps be affected by activities such as shipping?

- How will you know if a cap is damaged?
- Please describe the size of Pier 53 cap and the monitoring program for biological recolonization.
- Are there ghost shrimp in Elliott Bay?
- Are small outfalls on Harbor Island being considered?
- Has sufficient sampling been done to determine discrete project site boundaries?
- If there is a continuum along the waterfront with a link to Harbor Island, how do you plan to isolate a "partial" project?
- It appears that you haven't considered hydrology in your criteria for project selection. Why not?
- Contaminated sediment sinks not addressed in criteria.
- Looking at your criteria and rankings, it appears that some intertidal sites are ranked lower than some large subtidal areas. Please explain.
- What is being done to address private outfalls?
- Does 10-year recontamination period start only after cleanup?
- Is data from Elliott Bay and/or the Duwamish River being tied to a computer model?
- Is recency of data being considered in terms of acceptance criteria for data?
- Are the data solely from surface sample grabs?

Glossary

Aquatic ecosystems. Interrelated and interacting communities and populations of plants and animals that depend on aquatic habitat.

Cleanup Screening Levels (CSL). Concentrations of sediment that may cause low levels of harm to some organisms in Puget Sound. Ecology uses these levels to identify contaminated sites for cleanup.

Combined sewer overflow (CSO). The discharge of a combination of untreated sewage and stormwater from the sanitary sewerage system to natural waters through overflow relief mechanisms and piping. Combined sewer overflows are associated with older portions of combined sewerage systems designed to accept both sewage and stormwater runoff. Combined sewer overflows occur during large storms when the volume of stormwater runoff entering the sewerage system causes the total volume of water and sewage to exceed the system's capacity. Discharge of this excess volume was designed to occur through combined sewer overflow pipes to prevent system failure, which can include backups, flooding and health hazards.

Covered area. See "Program area."

Creation of habitat. Creating wetlands from upland habitat that was not historically wetland.

DDT (dichlorodiphenyltrichloroethane, and related isomers). Organic compounds once used as insecticides.

Enhancement of habitat. Increasing the habitat function of sites currently providing marginal aquatic habitat value.

Estuarine. Relating to a partially enclosed coastal body of water that has a free connection with the open sea and within which seawater is measurably diluted with freshwater derived from land drainage.

Habitat attributes. Physical and biological characteristics of wetland habitats that foster fish and wildlife utilization by facilitating reproduction, foraging, refuge from predation and/or disturbance, and physiological adaptation.

Habitat development. Acquisition of living natural resources for the purpose of habitat restoration and replacement and any program, technique, method or other means of creating or enhancing aquatic or benthic habitat in Elliott Bay or the Duwamish River (Consent Decree, 1991).

Habitat function. The ability of a site or area to provide support for fish and wildlife species and their associated resources.

Habitat restoration. Returning historical aquatic habitat attributes to sites that are currently upland or degraded wetland.

HCH (hexachlorocyclohexane). Organic compound used as an insecticide.

Landscape ecology. An approach to habitat development emphasizing broad spatial scales and the ecological effects of the spatial patterning on ecosystems. Specifically, it considers the development and dynamics of spatial heterogeneity, interactions and exchanges across heterogeneous landscapes, the influences of spatial heterogeneity on biotic and abiotic processes, and the management of spatial heterogeneity.

Minimum Cleanup Levels (MCUL). The highest concentration of a contaminant that can be left at a site after cleanup.

Mitigation. Mitigation is implemented through a permit process, such as the U.S. Army Corps of Engineers' Section 404 permit program. Mitigation includes avoidance, minimization and finally compensation if other forms of mitigation are not completely successful. Compensatory mitigation can include restoration, enhancement and creation projects.

PAHs (polycyclic aromatic hydrocarbons). Organic compounds present in petroleum products, such as gasoline, and/or released by the combustion of these products.

PCBs (polychlorinated biphenyls). Very stable organic compounds used in oils in electrical equipment as hydraulic fluid and for other uses.

Program area (also called "covered area"). The embayment, known as Elliott Bay, on Puget Sound located between Alki Point and West Point and including the shoreline 10 meters upland from the mean high water line, and the Duwamish River from the point at which it discharges into Elliott Bay to the head of navigation (approximately river mile 6, incorrectly referred to as river mile 10 in the consent decree), including Harbor Island and the East and West Waterways around Harbor Island (Consent Decree, 1991).

Sediment capping. The placement of a layer of clean sediment over an area of contaminated sediment. A sediment cap is typically one to three feet thick. The purpose of capping is to isolate contaminated sediment from the marine environment and provide a clean habitat for bottom-dwelling and other marine organisms.

Sediment Quality Standards (SQS). Levels generally considered safe for organisms in Puget Sound — the long-term goal for sediment quality in the sound.

Sediment remediation. Any program, technique, method or other means of dredging, removing, cleansing, isolating, immobilizing, bioremediating, capping or containing

sediment that contain hazardous substances beneath the waters of Elliott Bay and the Duwamish River (Consent Decree, 1991).

Source control. Any program, technique, method or other means of restricting or eliminating the discharge or other release of hazardous substances into Metro and the City of Seattle combined sewer overflow and/or storm drain outfall systems (Consent Decree, 1991).

Acronyms

CCMP	Comprehensive Conservation and Management Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CSL	Cleanup Screening Levels
CSO	Combined sewer overflow
DDT	Dichlorodiphenyltrichloroethane
DNR	Washington State Department of Natural Resources
DWU	City of Seattle's Drainage and Wastewater Utility
EA	Environmental assessment, prepared under the National Environmental Policy Act
EBAP	Elliott Bay Action Program
EBAT	Elliott Bay Action Team
EIS	Environmental impact statement
EPA	U.S. Environmental Protection Agency
FONSI	Finding of no significant impact
HCH	Hexachlorocyclohexane
MCUL	Minimum Cleanup Standards
MTCA	Model Toxics Control Act
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PSDDA	Puget Sound Dredged Disposal Analysis
SEPA	State Environmental Policy Act
SIF	Shoreline Improvement Fund
SPIF	Shoreline Park Improvement Fund
SQS	Sediment Quality Standards
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code

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